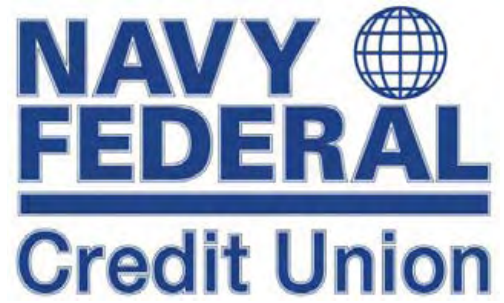


PROJECT MANUAL



Fort Worth Branch

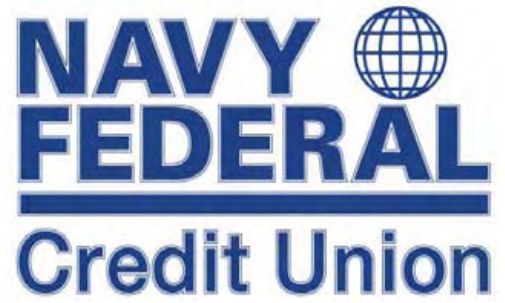
Prepared by



February 6, 2012



PROJECT MANUAL



Fort Worth Branch

Prepared by



February 6, 2012

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PART 1 - GENERAL

1.1 SUMMARY

A. **Work to be Bid:** The Scope of Work shall be as indicated in drawings and specifications. The Summary in the individual specification sections shall be used for the detailed scope of work covered in that section.

B. **Owner:**  
Navy Federal Credit Union  
820 Follin Ave.  
Vienna, VA 22180

Owner's Representative: Brian Murphy

C. **Architect/Engineer (A/E):**  
Schwarz-Hanson Architects  
2570 River Park Plaza Suite 100  
Fort Worth, Texas 76133

D. **Publication:** The Owner does not permit the duplication or publication of this RFP or any portion thereof. Furthermore, the Owner strictly prohibits the passing of this document in whole or part to any other person or organization not affiliated with the original addressee without the Owners prior written authorization.

E. **Special Instructions:**

1. All bidders shall omit pricing for carpet and adhesive materials associated with the Work as the owner has a purchasing agreement with the supplier. Carpet and adhesive materials will be delivered to the jobsite at the appropriate stage of the work. Bidders shall furnish labor and coordinate installation as well as warranty the carpet installation as part of their work.

2. All bidders shall omit pricing for quartz counter top material associated with the teller line work only as the owner has a purchasing agreement with the supplier. Quartz counter top materials will be delivered to the Millwork/Counter top subcontractor at the appropriate stage of the work. Bidders shall coordinate fabrication, furnish labor and installation as well as warranty the quartz counter top fabrication and installation as part of their work.

3. All bidders shall include a quote from Strategic Supply, Global Solution for Healthier Environments, along with any other bids that the bidder chooses to submit for Dyson hand dryer.

F. Product substitution:

Comparable products or substitutions for Contractor's convenience **WILL NOT** be considered after the bidding phase. See section 016000 for procedural requirements.

1.2 PROJECT SITE LOCATION

- A. Navy Federal Credit Union  
Fort Worth Branch  
6400 Westworth BLVD.  
City of Westworth Village, TX 76114

1.3 PROJECT DURATION

- A. 171 business days from Construction start date to Substantial Completion date. Final completion date shall be (fourteen) 14 calendar days after Substantial Completion date. This project has been submitted for Building Permit, and construction will commence on (tentative) April 16,2012 - unless notice to proceed is sooner.

1.4 DEFINITIONS

- A. Bidding Documents:
  1. Civil/Site drawings produced by URS Corporation
  2. Building package produced by Schwarz-Hanson Architects
- B. Addenda: Written or graphic documents issued by A/E prior to execution of Owner-Contractor Agreement which interpret or modify Project Manual or Drawings.
- C. Bid: Complete and properly signed offer to execute Work for sums stipulated in Bid Form and submitted in accordance with Bidding Documents.

- D. Bidder: Person or entity which submits Bid for Work described in Bidding Documents.
- E. Subbidder: Person or entity which submits proposal to Bidder for portion of Work described in Bidding Documents.
- F. Lump Sum Fee: The Contractor's fee for execution of the Work. The Lump Sum Fee shall include:
  - 1. Material
  - 2. Labor
  - 3. Profit
  - 4. Costs of premiums for all bonds and insurance, permits and fees.
  - 5. Overhead labor (superintendence/management, safety program, main and field office, etc.) associated with management, schedule maintenance and cost control of all sub-contracts including self-perform work.
  - 6. Overhead expense (field offices, consumables, expendables, etc.) associated with management, schedule maintenance and cost control of all sub-contracts including self-perform work.

## 1.5 BID DOCUMENTS

- A. Bid Documents:
  - 1. Eighty-four (84) 24" x 36" drawing sheets dated February 6, 2012. (Note: Civil Drawing dates may vary)
  - 2. Bound book specification (single volume) dated 02/6/2012. Building package produced by Schwarz-Hanson Architects)
- B. Bidders will receive bid documents (hard copy and PDF) on or about February 13, 2012. PDF file is provided for internal and sub bidder use only.
- C. Owner and A/E do not assume responsibility for errors or misinterpretations resulting from use of incomplete sets of Bidding Documents.
- D. Bidder shall promptly notify A/E of ambiguities, inconsistencies or errors which Bidder discovers during examination of Bidding Documents, Project Site, or local conditions.
- E. A/E will issue interpretations and modifications to Bidding Documents by written Addendum. Interpretations and modifications made in another manner will not be binding.
- F. Addenda will be furnished to all Bidders.
- G. Owner and A/E make Bid Documents available only for purpose of obtaining a Bid and do not convey a license or grant permission for other use.



- H. Return of bid documents – Nonresponsive and unsuccessful bidders shall return all bid documents to the A/E promptly and in good (reusable) condition. Failure to return bid documents may lead to the removal of your company from future Bid consideration.

#### 1.6 PREBID MEETING

- A. Bidders are required to attend a pre-bid meeting at the project site or call into the pre-bid conference meeting to be scheduled by the Owner's Representative.

#### 1.7 PREBID QUESTIONS

- A. All questions (technical and non-technical) during bidding shall be directed to the A/E's construction admin department via email in a RFI form at the following address: <nick@schwarz-hanson.com> Bid questions in any other form will not be accepted.
- B. All prebid questions shall be submitted by the primary bidder (i.e. - general contractor); questions submitted by any party other than the primary bidder will not be accepted.
- C. All prebid questions should be submitted no later than close of business on March 16, 2012
- D. Response to prebid questions will be distributed to all bidders.

#### 1.8 BID FORM AND STYLE

- A. Bid shall be submitted on Bid Form provided in Section 000412. All blanks on Bid Form shall be filled in by typewriter or printed in ink.
- B. Alterations and erasures of entries made by Bidder shall be initialed by signer of Bid.
- C. Where so indicated by make-up of Bid Form, Bid sums shall be expressed in both words and figures. In case of discrepancy between such entries, the sums expressed in words shall govern.
- D. Bid shall state legal name of Bidder and be signed by person or persons legally authorized to bind Bidder to a contract. Bid submitted by a corporation shall indicate state of incorporation and bear corporate seal.

#### 1.9 BID SUBMISSION

Bid submissions must be received by March 23, 2012 by 3pm CST. Bids are to be sent or delivered to:

Gerry H. Schwarz, AIA  
Schwarz-Hanson Architects  
2570 River Park Plaza Suite 100  
Fort Worth, Texas 76116

- A. Bids shall be received no later than time designated herein for Bid opening. Bids received after such time will be returned unopened.
- B. Only hard copies of the proposals/bids will be accepted. Submit 1 original and 1 copy of bid and all attachments thereto. Hard copies of bids and attachments shall be enclosed in a sealed, opaque envelope (hereinafter referred to as ‘Bid Envelope’).

Closed Bids -The evaluation of all proposals/bids shall be internal to the A/E and the Owner, and proposals shall not be made public or open to review among competitors.

- C. Bid Envelope:
  - 1. Include the following in lower-left corner of bid envelope: Bidder's name, address, applicable license numbers, and telephone number.
  - 2. If Bid is mailed, enclose bid envelope in separate mailing envelope which bears notation "Bid Enclosed" in lower-left corner.
  - 3. If Bid is delivered by express delivery service, enclose bid envelope in delivery pouch. Include notation "Bid Enclosed" on face of delivery pouch.
- D. Purchase Obligation – The Owner will not pay for any information, demonstrations, materials, presentations or any other costs you incur as a result of responses to this RFP. All costs associated with the preparation of a Proposal in response to this RFP will be borne solely by the supplier.
- E. Ownership of Responses - Documents submitted in response to this RFP will become the exclusive property of the Owner. Proposals will be used solely by the Owner and will not be distributed or made available in whole or in part outside of the Owner.

#### 1.10 MODIFICATION OR WITHDRAWAL OF BID

Bid submitted prior to time designated for Bid opening may be modified or withdrawn only by written notice to the A/E. Faxed notice will be accepted only for purpose of withdrawing a Bid and only if received prior to Bid deadline. Fax number for such notice is 817-377-3612 attention Gerry Schwarz.

#### 1.11 BID OPENING

- A. Bids will be opened and read in private.
- B. Bidder has full responsibility for timely delivery of Bid.

#### 1.12 CONSIDERATION OF BID

- A. Owner has right to reject Bid when investigation of business and technical organization of Bidder available for Project, including financial resources and experience on similar projects, does not satisfy Owner that Bidder is qualified in all respects to perform Work.

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- B. In determining qualifications of Bidder, Owner has right to take into consideration Bidder's past performance on other projects undertaken for Owner.
- C. Owner has right to reject any and all Bids for any reason, to accept any Bid considered best for Owner's interests, and to waive informalities or irregularities in any Bid.
- D. Owner has right to reject any subcontractor, vendor or supplier proposed for use on the project.

#### 1.13 BIDDER'S REPRESENTATIONS

- A. By submitting Bid, Bidder represents it has read and understood Bidding Documents, has examined Project site and adjoining areas, is familiar with obstacles and conditions that will affect Work, and has prepared its Bid in accordance with Bidding Documents.
- B. By submitting Bid, Bidder also represents its examination of Project site included measurement of unconcealed elements of existing construction that will be affected by Work and taken those measurements into account when preparing Bid.
- C. By submitting a Bid, Bidder acknowledges that dimensions and existing conditions described in Bidding Documents are approximate only and do not provide complete information. By submitting a Bid, Bidder further represents that it has taken field measurements, verified existing conditions, and prepared its Bid in accordance therewith.
- D. By submitting Bid, Bidder further represents it has satisfied all licensing laws related to Work described in Bidding Documents.

#### 1.14 EXAMINATION OF PROJECT SITE

- A. Bidder will have opportunity to conduct examination of project site by coordinating site visit(s) with the Owner's Representative.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 000201

SECTION 000308 - INFORMATION AVAILABLE TO BIDDERS

PART 1 - GENERAL

1.1 REFERENCE DOCUMENTS

- A. DRAFT- AIA Document A 107 – 2007, Standard Form of Agreement between Owner and Contractor.

- 1. DRAFT- AIA Document A107 is attached at the conclusion of this section.

- B. GEOTECHNICAL DATA AND TEST PILE RESULTS REPORT (Preliminary)

- 1. Geotechnical data provided includes soil boring log. The report and letters are attached at the conclusion of this section.
  - 2. The Geotechnical information is not a Contract Document. Such information is made available for Bidder's convenience and general information only. Conclusions made by Bidder from data provided in report are sole responsibility of Bidder. Owner and Engineer do not have or assume any responsibility for accuracy or completeness of information contained in report.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 000308

# DRAFT AIA<sup>®</sup> Document A107<sup>™</sup> - 2007

*Standard Form of Agreement Between Owner and Contractor for  
a Project of Limited Scope*

**NOTE:** THIS IS A DRAFT DOCUMENT  
ONLY AND REMAINS SUBJECT TO  
FURTHER REVISION BY NAVY  
FEDERAL CREDIT UNION.

**ADDITIONS AND DELETIONS:**  
The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

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

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AGREEMENT made as of the [redacted] day of [redacted] in the year 201[redacted].  
(In words, indicate day, month and year)

BETWEEN the Owner:  
(Name, address and other information)

Navy Federal Credit Union  
820 Follin Lane, S.E.  
Vienna, VA 22180

and the Contractor:  
(Name, address and other information)

for the following Project:  
(Name, location and detailed description)

The Architect:  
(Name, address and other information)

(The use of the term "Owner" is part of the Standard Form of Agreement; Navy Federal Credit Union may or may not own the property.)

The Owner and Contractor agree as follows:

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**ARTICLE 1 THE WORK OF THIS CONTRACT**

The Contractor shall execute the Work described in the Contract Documents listed in Article 6 of this Agreement or reasonably inferable by the Contractor from the Contract Documents as necessary to produce the results intended by the Contract Documents, except as specifically indicated in the Contract Documents to be the responsibility of others.

**ARTICLE 2 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION**

§ 2.1 The date of commencement of the Work shall be the date of this Agreement unless a different date is stated below or provision is made for the date to be fixed in a notice to proceed issued by the Owner.

[Redacted]

§ 2.2 The Contract Time shall be measured from the date of commencement.

§ 2.3 The Contractor shall achieve Substantial Completion of the entire Work as follows:

[Redacted]

[Redacted]

, subject to adjustments of the Contract Time as provided in the Contract Documents.

*(Insert provisions, if any, for liquidated damages relating to failure to achieve Substantial Completion on time or for bonus payments for early completion of the Work.)*

[Redacted]

§ 2.4 The Contractor acknowledges and agrees that the Owner will sustain extensive damages and serious losses as a result of the following acts or omissions on the part of the Contractor, its subcontractors, agents or employees: (1) failure to complete substantially or cause the Substantial Completion of any portion of the Work within the Contract Time; (2) failure to complete all Punch List Items (as defined in Section 19.6) within ten (10) days after Substantial Completion (the “Punch List Completion Date”); or (3) failure to obtain and deliver a certificate of occupancy to the Owner within ten (10) days after Substantial Completion (the “C/O Date”). Therefore, the Owner and the Contractor agree as set forth in this Section 2.4.

§ 2.4.1 Substantial Completion: If the Contractor fails to achieve Substantial Completion of the Work within the Contract Time, the Owner shall be entitled to retain or recover from the Contractor, as liquidated damages and not as a penalty, one thousand dollars (\$1,000.00) per day commencing upon the first day following expiration of the Contract Time and continuing until the actual date of Substantial Completion. Such liquidated damages are hereby agreed to be a reasonable pre-estimate of damages the Owner will incur as a result of delayed completion of the Work.

§ 2.4.2 Punch List Completion: If the Contractor fails to complete all Punch List Items by the Punch List Completion Date, the Owner shall be entitled to retain or recover from the Contractor, as liquidated damages and not as a penalty, one thousand dollars (\$1,000.00) per day commencing upon the first day following the Punch List Completion Date and continuing until the actual date all Punch List Items are completed. Such liquidated damages are hereby agreed to be a reasonable pre-estimate of damages the Owner will incur as a result of delayed completion of the Punch List Items.

§ 2.4.3 Certificate of Occupancy: If the Contractor fails to obtain and deliver a certificate of occupancy by the C/O Date, the Owner shall be entitled to retain or recover from the Contractor, as liquidated damages and not as a penalty, one thousand dollars (\$1,000.00) per day commencing upon the first day following the C/O Date and continuing until the actual date the certificate of occupancy is received by the Owner. Such liquidated damages are hereby agreed to be a reasonable pre-estimate of damages the Owner will incur as a result of delayed receipt of the certificate of occupancy.

§ 2.4.4 The Owner may deduct liquidated damages described in Subsections 2.4.1 through 2.4.3 from any unpaid amounts then or thereafter due the Contractor under this Agreement. Any liquidated damages not so deducted from any unpaid amounts due the Contractor shall be payable to the Owner at the demand of the Owner, together with interest from the date of the demand at a rate equal to the lower of the U.S. Prime Rate published in the Wall Street Journal on the date of such demand plus 2% or the highest lawful rate of interest payable by the Contractor.

### ARTICLE 3 CONTRACT SUM

§ 3.1 The Owner shall pay the Contractor the Contract Sum in current funds for the Contractor’s proper performance of the Contract and the completion of the Work. The Contract Sum, including the Contractor’s overhead and profits, shall be one of the following:  
(Check the appropriate box.)

- Stipulated Sum, in accordance with Section 3.2 below
- Cost of the Work plus the Contractor’s Fee, in accordance with Section 3.3 below
- Cost of the Work plus the Contractor’s Fee with a Guaranteed Maximum Price, in accordance with Section 3.4 below

(Based on the selection above, complete Section 3.2, 3.3 or 3.4 below.)



§ 3.2 The Stipulated Sum shall be [redacted] subject to additions and deletions as provided in the Contract Documents.

§ 3.2.1 The Stipulated Sum is based upon the following alternates, if any, which are described in the Contract Documents and are hereby accepted by the Owner:

*(State the numbers or other identification of accepted alternates. If the bidding or proposal documents permit the Owner to accept other alternates subsequent to the execution of this Agreement, attach a schedule of such other alternates showing the amount for each and the date when that amount expires.)*

N/A

§ 3.2.2 Unit prices, if any:

*(Identify and state the unit price, and state the quantity limitations, if any, to which the unit price will be applicable.)*

Item	Units and Limitations	Price Per Unit
None		

Such unit prices are considered complete and include (i) all materials, equipment, labor, delivery, installation, overhead, and profit and (ii) any other costs or expenses in connection with, or incidental to, the performance of that portion of the Work to which such unit prices apply.

§ 3.2.3 Allowances included in the stipulated sum, if any:

*(Identify allowance and state exclusions, if any, from the allowance price.)*

Item	Allowance
None	

### § 3.3 COST OF THE WORK PLUS CONTRACTOR'S FEE

§ 3.3.1 The Cost of the Work is as defined in Exhibit A, Determination of the Cost of the Work.

§ 3.3.2 The Contractor's Fee:

*(State a lump sum, percentage of Cost of the Work or other provision for determining the Contractor's Fee and the method of adjustment to the Fee for changes in the Work.)*

N/A

### § 3.4 COST OF THE WORK PLUS CONTRACTOR'S FEE WITH A GUARANTEED MAXIMUM PRICE

§ 3.4.1 The Cost of the Work is as defined in Exhibit A, Determination of the Cost of the Work.

§ 3.4.2 The Contractor's Fee:

*(State a lump sum, percentage of Cost of the Work or other provision for determining the Contractor's Fee and the method of adjustment to the Fee for changes in the Work.)*

N/A

### § 3.4.3 GUARANTEED MAXIMUM PRICE

§ 3.4.3.1 The sum of the Cost of the Work and the Contractor's Fee is guaranteed by the Contractor not to exceed [redacted] (\$ [redacted]), subject to additions and deductions by changes in the Work as provided in the Contract Documents. Such maximum sum is referred to in the Contract Documents as the Guaranteed Maximum Price. Costs which would cause the Guaranteed Maximum Price to be exceeded shall be paid by the Contractor without reimbursement by the Owner.

*(Insert specific provisions if the Contractor is to participate in any savings.)*

N/A

§ 3.4.3.2 The Guaranteed Maximum Price is based on the following alternates, if any, which are described in the Contract Documents and are hereby accepted by the Owner:

N/A

§ 3.4.3.3 Unit Prices, if any:

*(Identify and state the unit price, and state the quantity limitations, if any, to which the unit price will be applicable.)*

Item	Units and Limitations	Price Per Unit
None		

§ 3.4.3.4 Allowances included in the Guaranteed Maximum Price, if any:

*(Identify and state the amounts of any allowances, and state whether they include labor, materials, or both.)*

Item	Allowance

§ 3.4.3.5 Assumptions, if any, on which the Guaranteed Maximum Price is based:

None

#### ARTICLE 4 PAYMENTS

##### § 4.1 PROGRESS PAYMENTS

§ 4.1.1 Based upon Applications for Payment submitted to the Owner and the Architect by the Contractor including all supporting documents as hereinafter provided, and Certificates for Payment properly issued by the Architect, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided below and elsewhere in the Contract Documents. In addition to other required items, each Application for Payment shall be accompanied by the following, all in form and substance satisfactory to the Owner and in compliance with all applicable laws.

- .1 A current Sworn Statement from the Contractor setting forth all Subcontractors and any material suppliers with whom the Contractor has subcontracted, the amount of each such subcontract, the amount requested for any Subcontractor or material supplier in the Application for Payment and the amount to be paid to the Contractor from such progress payment, together with a current, duly executed waiver of mechanics' and material suppliers' liens from the Contractor establishing receipt of payment or satisfaction of the payment requested by the Contractor in the current Application for Payment.
- .2 Commencing with the second (2<sup>nd</sup>) Application for Payment submitted by the Contractor, duly executed so-called "after-the-fact" waivers of mechanics' and material suppliers' liens from all Subcontractors, material suppliers and, where appropriate, lower tier subcontractors, establishing receipt of payment or satisfaction of payment of all amounts requested on behalf of such entities and disbursed prior to submittal by the Contractor of the current Application for Payment, plus sworn statements from all Subcontractors, material suppliers, and, where appropriate, lower tier subcontractors, covering all amounts described in this Subsection 4.1.1.2.
- .3 Statements indicating the amount paid by the Owner to the Contractor pursuant to the previous Application for Payment, if any, and the total amount paid by Owner to Contractor to date.

- .4 Such other information, documentation, and materials as the Owner or the Architect may require.
- .5 All applications for payment submitted by the Contractor will provide the division, subdivision and description of each line item charge in accordance with the classifications for that line item as set forth in the Master Format of the Construction Specifications Institute (CSI).
- .6 All applications for payment submitted by the Contractor will include satisfactory written evidence that each surety, bond provider, and/or guarantor of any of the Contractor's obligations under this Agreement has consented to the payment being requested. The Owner will have the right to accept or reject that evidence in its sole discretion.

§ 4.1.2 The period covered by each Application for Payment shall be one calendar month ending on the last day of the month, or as follows:

N/A

§ 4.1.3 Provided that an Application for Payment is received by the Architect not later than the fifteenth (15<sup>th</sup>) day of a month, the Owner shall make payment of the certified amount to the Contractor not later than the fifteenth (15<sup>th</sup>) day of the following month. If an Application for Payment is received by the Architect after the date fixed above, payment shall be made by the Owner not later than thirty (30) days after the Architect receives the Application for Payment.

*(Federal, state or local laws may require payment within a certain period of time.)*

§ 4.1.4 Retainage, if any, shall be withheld as follows:

Owner shall withhold up to ten percent (10%) of each progress payment as retainage (the "Retainage"). The Retainage shall be paid to the Contractor following the Owner's receipt of (i) the Architect's final Certificate for Payment, and (ii) the issuance by the Owner or the Architect of an executed Punch List Close-Out (as defined in Section 19.6 of this Agreement).

§ 4.1.5 Payments due and unpaid under the Contract shall bear interest from the date payment is due at the rate stated below, or in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

Four Percent (4%)

## § 4.2 FINAL PAYMENT

§ 4.2.1 Final payment, constituting the entire unpaid balance of the Contract Sum, shall be made by the Owner to the Contractor when:

- .1 the Contractor has fully performed the Contract except for the Contractor's responsibility to correct Work as provided in Section 18.2, and to satisfy other requirements, if any, which extend beyond final payment;
- .2 the contractor has submitted a final accounting for the Cost of the Work, where payment is on the basis of the Cost of the Work with or without a guaranteed maximum price;
- .3 a final Certificate for Payment has been issued by the Architect;
- .4 issuance by the Owner or the Architect of an executed Punch List Close-Out; and
- .5 all other conditions for final payment contained in this Agreement have been satisfied.

§ 4.2.2 The Owner's final payment to the Contractor shall be made no later than thirty (30) days after the issuance of the Architect's final Certificate for Payment, or as follows:

ARTICLE 5 DISPUTE RESOLUTION

§ 5.1 BINDING DISPUTE RESOLUTION

For any claim subject to, but not resolved by, mediation pursuant to Section 21.3, the method of binding dispute resolution shall be as follows:

(Check the appropriate box. If the Owner and Contractor do not select a method of binding dispute resolution below, or do not subsequently agree in writing to a binding dispute resolution method other than litigation, claims will be resolved in a court of competent jurisdiction.)

- Arbitration pursuant to Section 21.4 of this Agreement
- Litigation in a court of competent jurisdiction
- Other (Specify)

ARTICLE 6 ENUMERATION OF CONTRACT DOCUMENTS

§ 6.1 The Contract Documents are defined in Article 7 and, except for Modifications issued after execution of this Agreement, are enumerated in the sections below.

§ 6.1.1 The Agreement is this executed AIA Document A107–2007, Standard Form of Agreement Between Owner and Contractor for a Project of Limited Scope.

§ 6.1.2 The Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages

§ 6.1.3 The Specifications:

(Either list the Specifications here or refer to an exhibit attached to this Agreement.)

§ 6.1.4 The Drawings:

(Either list the Drawings here or refer to an exhibit attached to this Agreement.)

§ 6.1.5 The Addenda, if any:

Number	Date	Pages

Portions of Addenda relating to bidding requirements are not part of the Contract Documents unless the bidding requirements are enumerated in this Article 6.

§ 6.1.6 Additional documents, if any, forming part of the Contract Documents:

- .1 Exhibit A, Determination of the Cost of the Work, if applicable.
- .2 AIA Document E201™–2007, Digital Data Protocol Exhibit, if completed, or the following:
- .3 Other documents:  
(List here any additional documents that are intended to form part of the Contract Documents.)

## ARTICLE 7 GENERAL PROVISIONS

### § 7.1 THE CONTRACT DOCUMENTS

The Contract Documents are enumerated in Article 6 and consist of this Agreement (including, if applicable, Supplementary and other Conditions of the Contract), Drawings, Specifications, Addenda issued prior to the execution of this Agreement, other documents listed in Article 6 of this Agreement and Modifications issued after execution of this Agreement. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive or (4) a written order for a minor change in the Work issued by the Architect. The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results. In the event of inconsistencies within or between parts of the Contract Documents, or between the Contract Documents and applicable standards, codes, and ordinances, the Contractor shall (i) provide the better quality or greater quantity of Work or (ii) comply with the more stringent requirement, either or both in accordance with the Architect's interpretation, provided, that in the case of such inconsistency, the Contractor will promptly notify the Owner, in writing, of such inconsistency and the actions it took to resolve the inconsistency.

### § 7.2 THE CONTRACT

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

### § 7.3 THE WORK

The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project.

### § 7.4 INSTRUMENTS OF SERVICE

Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Architect and the Architect's consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.

### § 7.5 OWNERSHIP AND USE OF DRAWINGS, SPECIFICATIONS AND OTHER INSTRUMENTS OF SERVICE

§ 7.5.1 The Owner, the Architect and the Architect's consultants shall be deemed the authors and co-owners of their respective Instruments of Service, including the Drawings and Specifications. The Contractor, Subcontractors, Sub-subcontractors, and material or equipment suppliers shall not own or claim a copyright in the Instruments of Service. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with this Project is not to be construed as publication in derogation of the Owner's, Architect's or Architect's consultants' reserved rights.

§ 7.5.2 The Contractor, Subcontractors, Sub-subcontractors and material or equipment suppliers are authorized to use and reproduce the Instruments of Service provided to them solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and material or equipment suppliers may not use the Instruments of Service on other projects or for additions to this Project outside the scope of the Work without the specific written consent of the Owner, Architect and the Architect's consultants.

## § 7.6 TRANSMISSION OF DATA IN DIGITAL FORM

If the parties intend to transmit Instruments of Service or any other information or documentation in digital form, they shall endeavor to establish necessary protocols governing such transmission, unless otherwise provided in this Agreement or in the Contract Documents.

## § 7.7 KNOWLEDGE

The terms “knowledge,” “recognize,” and “discover,” their respective derivatives, and similar terms in the Contract Documents, as used in reference to the Contractor, shall be interpreted to mean that which the Contractor knows (or should know), recognizes (or should recognize), and discovers (or should discover) in exercising the care, skill, and diligence required by the Contract Documents. Analogously, the expression “reasonably inferable” and similar terms in the Contract Documents shall be interpreted to mean reasonably inferable by a contractor familiar with the Project and exercising the care, skill, and diligence required of the Contractor by the Contract Documents.

## § 7.8 CONFIDENTIALITY

§ 7.8.1 The Contractor warrants and represents that the Contractor shall not knowingly or negligently communicate or disclose at any time to any person or entity any information in connection with the Work or the Project except (i) with prior written consent of the Owner, (ii) information that was in the public domain prior to the date of this Agreement, (iii) information that becomes part of the public domain by publication or otherwise not due to any unauthorized act or omission of the Contractor, or (iv) as may be required to perform the Work or by any applicable law.

§ 7.8.2 The Contractor, at any time upon the request of the Owner, shall immediately return and surrender to the Owner all copies of any materials, records, notices, memoranda, recordings, drawings, specifications, and mock-ups and any other documents furnished by the Owner or the Architect to the Contractor.

§ 7.8.3 The Contractor shall cause all Subcontractors or any other person or entity performing any services or furnishing any materials or equipment for the Work to warrant and represent all items set forth in this Section 7.8.

§ 7.8.4 The representations and warranties contained in this Section 7.8 shall survive the complete performance of the Work or earlier termination of this Agreement.

## ARTICLE 8 OWNER

### § 8.1 INFORMATION AND SERVICES REQUIRED OF THE OWNER

§ 8.1.1 The Owner shall furnish all necessary surveys and a legal description of the site.

§ 8.1.2 The Contractor shall be entitled to reasonably rely on the information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work. The parties understand and agree, however, that Owner makes no representation, warranty or guarantee, either express or implied, as to the adequacy of efficacy of the information or documents provided or prepared by others, whether or not furnished to Contractor by or through Owner.

§ 8.1.3 Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 9.6.1, the Owner shall secure and pay for other necessary approvals, easements, assessments and charges required for the construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

### § 8.2 OWNER'S RIGHT TO STOP THE WORK

If the Contractor fails to correct Work which is not in accordance with the requirements of the Contract Documents, or fails to carry out the Work in accordance with the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such

order is eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity.

### § 8.3 OWNER'S RIGHT TO CARRY OUT THE WORK

If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents, and fails within a **ten ( 10 )** day period after receipt of written notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner, without prejudice to any other remedy the Owner may have, may correct such deficiencies and may deduct the reasonable cost thereof, including Owner's expenses and compensation for the Architect's services made necessary thereby, from the payment then or thereafter due the Contractor.

### § 8.4 EXTENT OF OWNER'S RIGHTS

§ 8.4.1 The rights stated in this Article 8 and elsewhere in the Contract Documents are cumulative and not in limitation of any rights of the Owner (i) granted in the Contract Documents, (ii) at law, or (iii) in equity.

§ 8.4.2 In no event shall the Owner have control over, charge of, or any responsibility for construction means, methods, techniques, sequences, or procedures or for safety precautions and programs in connection with the Work, notwithstanding any of the rights and authority granted the Owner in the Contract Documents.

## ARTICLE 9 CONTRACTOR

### § 9.1 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

§ 9.1.1 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed and correlated personal observations with requirements of the Contract Documents. Prior to execution of this Agreement, the Contractor and each Subcontractor evaluated and satisfied themselves as to the conditions and limitations under which the Work is to be performed, including without limitation, (i) the location, conditions, layout, and nature of the Project site and surrounding areas, (ii) generally prevailing climatic conditions, (iii) anticipated labor supply and costs, (iv) availability and cost of materials, tools, and equipment, and (v) other similar issues. The Owner assumes no responsibility or liability for the physical condition or safety of the Project site or any improvements located on the Project site. Except as set forth elsewhere in this Contract, the Contractor shall be solely responsible for providing a safe place for the performance of the Work. The Owner shall not be required to make any adjustment in either the Contract Sum or Contract Time in connection with any failure by the Contractor or any Subcontractor to have complied with the requirements of this Section 9.1.1.

§ 9.1.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 8.1.1, shall take field measurements of any existing conditions related to that portion of the Work and shall observe any conditions at the site affecting it. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the design information contained in the Contract Documents; however, the Contractor shall promptly report to the Owner and the Architect any errors, inconsistencies, or omissions discovered by or made known to the Contractor as a request for information in such form as the Owner and the Architect may require. It is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional unless otherwise specifically provided in the Contract Documents.

§ 9.1.2.1 The exactness of grades, elevations, dimensions, or locations on any Drawing or Specifications issued by the Architect, or the work installed by other contractors, is not guaranteed by the Architect or the Owner.

§ 9.1.2.2 The Contractor shall, therefore, satisfy itself as to the accuracy of all grades, elevations, dimensions, or locations. In all cases of interconnection of its Work with existing or other work, the Contractor shall verify at the site all dimensions relating to such existing or other work. Any errors due to the Contractor's failure to so verify all such grades, elevations, dimensions, or locations shall be promptly rectified by the Contractor without any additional cost to the Owner.

§ 9.1.2.3 All of Contractor's work shall conform to the Contract Documents. No change therefrom shall be undertaken without the prior review by the Architect and approval of the Owner. The Contractor shall be responsible for details of the Work necessary to carry out the intent of the Drawings and Specifications, or which are customarily performed. When more detailed information is required for performance of the Work or when an interpretation of the Contract Documents is requested, the Contractor shall submit a written request to the Architect and the Owner, and the Architect shall furnish such information or interpretation in the form of an Architect's Supplemental Instruction or other medium. Where only part of the Work is indicated, similar parts shall be considered repetitive. Where any detail is shown and components thereof are fully described, similar details not fully described shall be considered to incorporate the fully described details and components. In the case of inconsistency between any Drawings and Specifications or documents or drawings prepared by the Architect or the Owner, the better quality or greater quantity shall be provided in accordance with the Architect's interpretation at no extra cost to the Owner.

§ 9.1.3 The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall promptly report to the Owner and the Architect any nonconformity discovered by or made known to the Contractor as a request for information in such form as the Owner and the Architect may require.

§ 9.1.4 The Contractor shall comply with all applicable Federal, state and local laws, statutes, rules, codes, orders, regulations, and ordinances including but not limited to all immigration, environmental, tax, social security, unemployment compensation, workers' compensation and safety laws, statutes, rules, codes, orders, and regulations (collectively, "Applicable Laws"). The Contractor shall also maintain at all times during the term of the prime contract (and for the time otherwise required by law) all records required by the United States Citizenship and Immigration Services ("USCIS"), including without limitation, the completion and maintenance of the Form I-9 for each of the Contractor's employees and shall respond at all times during the term of the prime contract in a timely fashion to any inspection request related to such I-9 forms by the Contractor, the Owner or governmental agency or authority. Furthermore, during the term of this Agreement (and for the time otherwise required by law), the Contractor shall cause its officers, directors, managers, agents, and employees to cooperate fully in all respects with an audit, inquiry, inspection, or investigation that may be conducted by the USCIS of the Contractor or any of its employees or subcontractors. The Contractor shall immediately, and in any event within two (2) hours of the Contractor's first notice of an event described in this sentence, notify the Owner in writing and by in-person voice communications (not voicemail) of any unscheduled inspections, raids, investigations, inquiries, visits, or audits conducted by the USCIS, OSHA, or any other governmental agency or authority related to environmental, immigration, or employee safety issues of the Contractor, its agents, employees, subcontractors, or sub-subcontractors. The Contractor shall, on a monthly basis during the term of this Agreement, conduct an audit of the I-9 forms for its employees and shall promptly correct any defects or deficiencies that are identified as a result of such audit. The Owner may, in its sole discretion, terminate this Agreement immediately if, at any time during the term of this Agreement, the Contractor violates or is in breach of any provision of this Subsection, or the USCIS determines that the Contractor has not complied with any Applicable Laws or any other applicable law or ordinance, including without limitation the Immigration Reform and Contract Act of 1986, as amended, and the Illegal Immigration Reform and Immigration Responsibility Act of 1996, as amended, and any successor statutes thereto. If an employee of the Contractor or if the Contractor is later determined to not have valid I-9 information then that employee shall be removed and barred from the Project site at the Contractor's expense. The Contractor shall require



all of its Subcontractors and Sub-subcontractors to make the representations and warranties set forth in this Subsection and to be bound by the same requirements set forth in this Subsection.

## § 9.2 SUPERVISION AND CONSTRUCTION PROCEDURES

§ 9.2.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences and procedures, and for coordinating all portions of the Work under the Contract, unless the Contract Documents give other specific instructions concerning these matters.

§ 9.2.2 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons or entities performing portions of the Work for or on behalf of the Contractor or any of its Subcontractors.

## § 9.3 LABOR AND MATERIALS

§ 9.3.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

§ 9.3.2 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of unfit persons or persons not skilled in tasks assigned to them.

§ 9.3.3 The Contractor may make a substitution only with the consent of the Owner, after evaluation by the Architect and in accordance with a Modification. All materials are to be installed according to the manufacturer's recommendations, regardless of whether specific installation instructions are provided in the Contract Documents. If the Contractor desires to submit an alternative product or method in lieu of what has been specified or shown in the Contract Documents, the following provisions apply:

- .1 The Contractor must submit to the Architect and the Owner (i) a full explanation of the proposed substitution and submittal of all supporting data, including technical information, catalog cuts, warranties, test results, installation instructions, operating procedures, and other like information necessary for a complete evaluation of the substitution; (ii) a written explanation of the reasons the substitution is advantageous and necessary, including the benefits to the Owner and the Work in the event the substitution is acceptable; (iii) the adjustment, if any, in the time of completion of the Contract and the construction schedule in the event the substitution is acceptable; and (v) an affidavit stating that (a) the proposed substitution conforms and meets all the requirements of the pertinent Specifications and the requirements shown on the Drawings, and (b) the Contractor accepts the warranty and correction obligations in connection with the proposed substitution as if originally specified by the Architect. Proposals for substitutions shall be submitted in triplicate to the Architect in sufficient time to allow the Architect no less than three (3) days for review. No substitutions will be considered or allowed without the Contractor's submittal of complete substantiating data and information as stated hereinbefore.
- .2 Substitutions and alternatives may be rejected without explanation and will be considered only under one or more of the following conditions: (i) the proposal is required for compliance with interpretation of code requirements or insurance regulations then existing; (ii) specified products are unavailable, through no fault of the Contractor; (iii) subsequent information discloses inability of specified products to perform properly or to fit in designated space; (iv) the manufacturer/fabricator refuses to certify or guarantee performance or specified product as required; and (v) when in the judgment of the Owner or the Architect, a substitution would be substantially in the Owner's best interests, in terms of cost, time, or other considerations.

- 3 Whether or not any proposed substitution is accepted by the Owner or the Architect, the Contractor shall reimburse the Owner for any fees charged by the Architect or other consultants for evaluating the proposed substitute.

#### § 9.4 WARRANTY

The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements shall be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation or normal wear and tear under normal usage. The Contractor agrees to assign to the Owner at the time of final completion of the Work any and all manufacturer's warranties relating to materials and labor used in the Work and further agrees to perform the Work in such manner so as to preserve any and all such manufacturer's warranties. The Contractor agrees to (i) send an authorized employee to the Project within five (5) business days after being notified that the Owner is making any claim under this Section 9.4 to discuss the claim with designated representatives of the Owner, and (ii) make any required repairs, replacements, corrections, or undertake any other measure in order to satisfy its obligations under this Section 9.4, within fifteen (15) days after it receives the claim notice from the Owner.

#### § 9.5 TAXES

The Contractor shall pay sales, consumer, use and other similar taxes that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

#### § 9.6 PERMITS, FEES, NOTICES, AND COMPLIANCE WITH LAWS

§ 9.6.1 Except as set forth in Subsection 8.1.3, the Contractor shall secure, pay for, and, as soon as practicable, furnish the Owner with copies or certificates of all permits and fees, licenses, and inspections necessary for the proper execution and completion of the Work, including, without limitation, all building permits, site permits and all civil permits. All connection charges, assessments, or inspection fees as may be imposed by any municipal agency or utility company are included in the Contract Sum and shall be the Contractor's responsibility.

§ 9.6.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders and all other requirements of public authorities applicable to performance of the Work. If the Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

#### § 9.7 ALLOWANCES

The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. The Owner shall select materials and equipment under allowances with reasonable promptness. Allowance amounts shall include the costs to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts. Allowance amounts shall not include the Contractor's costs for unloading and handling at the site, labor, installation, overhead, and profit. The Contractor shall account for all allowances and report to the Owner when allowance amounts have reached the levels agreed to in the Contract Documents. Any remainder amounts in an allowance are to be provided to the Owner as a credit on the sums due to the Contractor.

#### § 9.8 CONTRACTOR'S CONSTRUCTION SCHEDULES

§ 9.8.1 The Contractor, promptly after being awarded the Contract, shall prepare and submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall not exceed time limits current under the Contract Documents, shall be revised at appropriate intervals as

required by the conditions of the Work and Project, shall be related to the entire Project to the extent required by the Contract Documents, and shall provide for expeditious and practicable execution of the Work.

§ 9.8.2 The Contractor shall perform the Work in general accordance with the most recent schedule submitted to the Owner and Architect.

#### § 9.9 SUBMITTALS

§ 9.9.1 The Contractor shall review for compliance with the Contract Documents and submit to the Architect Shop Drawings, Product Data, Samples and similar submittals required by the Contract Documents in coordination with the Contractor's construction schedule and in such sequence as to allow the Architect reasonable time for review. By submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor represents to the Owner and Architect that the Contractor has (1) reviewed and approved them; (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so; and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents. The Work shall be in accordance with approved submittals.

§ 9.9.2 Shop Drawings, Product Data, Samples and similar submittals are not Contract Documents.

#### § 9.10 USE OF SITE

The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, lawful orders of public authorities, and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

§ 9.10.1 Only materials and equipment that are to be used directly in the Work shall be brought to and stored on the Project site by the Contractor. After equipment is no longer required for the Work, it shall be promptly removed from the Project site. Protection of construction materials and equipment stored at the Project site from weather, theft, damage, and all other adversity is solely the responsibility of the Contractor. The Contractor shall ensure that the Work, at all times, is performed in a manner that affords reasonable access, both vehicular and pedestrian, to the site of the Work and all adjacent areas. The Work shall be performed, to the fullest extent reasonably possible, in such a manner that public areas adjacent to the site of the Work shall be free from all debris, building materials, and equipment likely to cause hazardous conditions.

§ 9.10.2 The Contractor and any entity for whom the Contractor is responsible shall not erect any sign on the Project site without the prior written consent of the Owner, which may be withheld at the sole discretion of the Owner.

§ 9.10.3 Without limitation of any other provision of the Contract Documents, the Contractor shall use best efforts to minimize any interference with the occupancy or beneficial use of (i) any areas and buildings adjacent to the site of the Work, and (ii) the Building, in the event of partial occupancy. Without prior approval of the Owner, the Contractor shall not permit any workers to use any existing facilities at the Project site, including, without limitation, lavatories, toilets, entrances, and parking areas other than those designated by the Owner.

§ 9.10.3.1 Without limitation of any other provision of the Contract Documents, the Contractor shall use its best efforts to comply with all rules and regulations promulgated by the Owner in connection with the use and occupancy of the Project site and the Building, as amended from time to time. The Contractor shall immediately notify the Owner in writing if during the performance of the Work, the Contractor finds compliance of any portion of such rules and regulations to be impracticable, setting forth the problems of such compliance and suggesting alternatives through which the same results intended by such portions of the rules and regulations can be achieved. The Owner may, in the Owner's sole discretion, adopt such

suggestions, develop new alternatives, or require compliance with the existing requirements of the rules and regulations.

§ 9.10.3.2 The Contractor shall also comply with all insurance requirements and collective bargaining agreements applicable to use and occupancy of the Project site and the Building.

#### § 9.11 CUTTING AND PATCHING

The Contractor shall be responsible for cutting, fitting or patching required to complete the Work or to make its parts fit together properly.

#### § 9.12 CLEANING UP

The Contractor shall keep the premises and surrounding area free from accumulation of waste materials or rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove waste materials, rubbish, the Contractor's tools, construction equipment, machinery and surplus material from and about the Project. The Contractor, at its expense, shall furnish a full and final cleaning of the entire Project site prior to acceptance by the Owner.

#### § 9.13 ROYALTIES, PATENTS AND COPYRIGHTS

The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner and Architect harmless from loss on account thereof, but shall not be responsible for such defense or loss when a particular design, process or product of a particular manufacturer or manufacturers is required by the Contract Documents or where the copyright violations are contained in Drawings, Specifications or other documents prepared by the Owner or Architect. However, if the Contractor has reason to believe that the required design, process or product is an infringement of a copyright or a patent, the Contractor shall be responsible for such loss unless such information is promptly furnished to the Architect.

#### § 9.14 ACCESS TO WORK

The Contractor shall provide the Owner and Architect access to the Work in preparation and progress wherever located.

#### § 9.15 INDEMNIFICATION

§ 9.15.1 TO THE FULLEST EXTENT PERMITTED BY LAW, THE CONTRACTOR SHALL INDEMNIFY AND HOLD HARMLESS THE OWNER (AND ITS OFFICERS, DIRECTORS, MANAGERS, BOARD MEMBERS AND EMPLOYEES), ARCHITECT, ARCHITECT'S CONSULTANTS AND AGENTS AND EMPLOYEES OF ANY OF THEM (COLLECTIVELY, THE "INDEMNITEES") FROM AND AGAINST CLAIMS, DAMAGES, LOSSES AND EXPENSES, INCLUDING BUT NOT LIMITED TO ATTORNEYS' FEES, ARISING OUT OF OR RESULTING FROM (I) ANY BREACH OF THIS AGREEMENT, AND/OR (II) THE PERFORMANCE OF THE WORK, PROVIDED THAT SUCH CLAIM, DAMAGE, LOSS OR EXPENSE IS ATTRIBUTABLE TO BODILY INJURY, SICKNESS, DISEASE OR DEATH, OR TO INJURY TO OR DESTRUCTION OF TANGIBLE PROPERTY (OTHER THAN THE WORK ITSELF) (INCLUDING LOSS OF USE RESULTING THEREFROM), BUT ONLY TO THE EXTENT CAUSED BY THE NEGLIGENT ACTS OR OMISSIONS OF THE CONTRACTOR, A SUBCONTRACTOR, ANYONE DIRECTLY OR INDIRECTLY EMPLOYED BY THEM OR ANYONE FOR WHOSE ACTS THEY MAY BE LIABLE, REGARDLESS OF WHETHER OR NOT SUCH CLAIM, DAMAGE, LOSS OR EXPENSE IS CAUSED IN PART BY A PARTY INDEMNIFIED HEREUNDER. SUCH OBLIGATION SHALL NOT BE CONSTRUED TO NEGATE, ABRIDGE, OR REDUCE OTHER RIGHTS OR OBLIGATIONS OF INDEMNITY WHICH WOULD OTHERWISE EXIST AS TO A PARTY OR PERSON DESCRIBED IN THIS SECTION 9.15.1.

§ 9.15.2 In claims against any person or entity indemnified under this Section 9.15 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they

may be liable, the indemnification obligation under Section 9.15.1 shall not be limited by a limitation on amount or type of damages, compensation or benefits payable by or for the Contractor or Subcontractor under workers' compensation acts, disability benefit acts or other employee benefit acts.

§ 9.15.3 The Contractor's indemnity obligations under this Section 9.15 shall also specifically include, without limitation, all fines, penalties, damages, liability, costs, expenses (including, without limitation, reasonable attorneys' fees) and punitive damages (if any) arising out of, or in connection with, any (i) violation of or failure to comply with any law, statute, ordinance, rule, regulation, code, or requirements of a public authority that bears upon the performance of the Work by the Contractor, a Subcontractor, or any person or entity for whom either is responsible, (ii) means, methods, procedures, techniques, or sequences of execution or performance of the Work, and (iii) failure to secure and pay for permits, fees, approvals, licenses, and inspections as required under the Contract Documents, or any violation of any permit or other approval of a public authority applicable to the Work by the Contractor, a Subcontractor, or any person or entity for whom either is responsible.

§ 9.15.4 The Contractor shall indemnify and hold harmless all of the Indemnitees from and against any costs and expenses (including reasonable attorneys' fees) incurred by any of the Indemnitees in enforcing any of the Contractor's defense, indemnity, and hold harmless obligations under this Agreement.

## ARTICLE 10 ARCHITECT

§ 10.1 The Architect will provide administration of the Contract and will be an Owner's representative during construction, until the date the Architect issues the final Certificate for Payment. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents, unless otherwise modified in writing in accordance with other provisions of the Contract.

§ 10.2 The Architect will visit the site at intervals appropriate to the stage of the construction to become generally familiar with the progress and quality of the portion of the Work completed, and to determine in general, if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Architect will not have control over, charge of, or responsibility for, the construction means, methods, techniques, sequences or procedures, or for safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents.

§ 10.3 On the basis of the site visits, the Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and report to the Owner (1) known deviations from the Contract Documents and from the most recent construction schedule submitted by the Contractor, and (2) defects and deficiencies observed in the Work. The Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Owner and the Architect will not have control over or charge of and will not be responsible for acts or omissions of the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

§ 10.4 Based on the Architect's evaluations of the Work and of the Contractor's Applications for Payment, the Architect will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

§ 10.5 The Architect has authority to reject Work that does not conform to the Contract Documents and to require inspection or testing of the Work.

§ 10.6 The Architect will review and approve or take other appropriate action upon the Contractor's submittals such as Shop Drawings, Product Data and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents.

§ 10.7 The Architect will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. The Architect will make initial decisions (recommendations) on all claims, disputes and other matters in question between the Owner and Contractor but will not be liable for results of any interpretations or decisions rendered in good faith.

§ 10.8 The Architect's decisions on matters relating to aesthetic effect, in connection with administration of the Contract, will be final if consistent with the intent expressed in the Contract Documents.

§ 10.9 Duties, responsibilities and limitations of authority of the Architect as set forth in the Contract Documents shall not be restricted, modified or extended without written consent of the Owner, Contractor and Architect. Consent shall not be unreasonably withheld.

§ 10.10 Notwithstanding anything to the contrary in this Article 10 or this Agreement, the Owner, at any time prior to the issuance of notice to proceed, may elect in writing to designate either a third party or a member of the Owner's management team to serve in the role of the Architect (the "Alternative Administrator"), in which case all references in to the Architect shall be deemed to refer to the Alternative Administrator.

## ARTICLE 11 SUBCONTRACTORS

§ 11.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site.

§ 11.2 No later than five (5) days subsequent to the full execution of this Agreement, the Contractor shall furnish the Owner and the Architect, in writing, with (i) the name, trade, and subcontract amount for each Subcontractor or supplier and (ii) the names of all persons or entities proposed as manufacturers of the products identified in the Specifications (including those who are to furnish materials or equipment fabricated to a special design) and, where applicable, the name of the installing Subcontractor or supplier. The Contractor shall not contract with any Subcontractor or supplier to whom the Owner or Architect has made reasonable written objection within ten (10) days after receipt of the Contractor's list of Subcontractors and suppliers. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor's Work. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

§ 11.3 Contracts between the Contractor and Subcontractors shall (1) require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by the terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work, which the Contractor, by the Contract Documents, assumes toward the Owner and Architect, and (2) allow the Subcontractor the benefit of all rights, remedies and redress against the Contractor that the Contractor, by these Contract Documents, has against the Owner.

§ 11.4 All subcontracts shall be in writing in form and substance substantially similar to the Contractor's standard form subcontract, attached to this Agreement and made a part hereof as Exhibit B, and shall specifically provide that the Owner is an intended third-party beneficiary of such subcontract.

§ 11.5 The Contractor shall include in its subcontracts and purchase orders the requirement that subcontractors and suppliers shall provide all lien waivers required by this Agreement.

## ARTICLE 12 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

§ 12.1 The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and to award separate contracts in connection with other portions of the Project or other construction or operations on the site under conditions of the contract identical or substantially similar to these, including those portions related to insurance and waiver of subrogation. If the Contractor claims that delay or additional cost is involved because of such action by the Owner, the Contractor shall make such claim as provided in Article 21.

§ 12.2 The Contractor shall afford the Owner and separate contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's activities with theirs as required by the Contract Documents.

§ 12.3 The Owner shall be reimbursed by the Contractor for costs incurred by the Owner which are payable to a separate contractor because of delays, improperly timed activities or defective construction of the Contractor. The Owner shall be responsible to the Contractor for costs incurred by the Contractor because of delays, improperly timed activities, damage to the Work or defective construction of a separate contractor.

§ 12.4 The Contractor shall, as part of the Work, provide for the coordination of work to be performed by each separate contractor engaged by the Owner, if any, with the work to be performed by the Contractor or its Subcontractors of any tier. The Contractor shall use its best efforts to cooperate with the Owner and all separate contractors, their subcontractors, and any other entity involved in the performance by separate contractors to be completed in an expeditious manner, the Contractor agrees that it will ensure that such separate contractors have a reasonable opportunity to complete their work as and when required.

§ 12.5 If any part of the Work depends upon the proper performance of the work of a separate contractor, the Contractor shall, prior to proceeding with the Work, promptly report to the Owner any apparent discrepancies or defects in such other work that render it unsuitable and prevent the Contractor from proceeding expeditiously with the Work.

§ 12.6 If the Contractor wrongfully causes damage to the Work or property of the Owner, the Contractor shall promptly remedy such damage. If the Contractor wrongfully causes damage to the work or property of any separate contractor, the Contractor shall promptly attempt to settle any resulting dispute or claim with such other contractor.

## ARTICLE 13 CHANGES IN THE WORK

§ 13.1 By appropriate Modification, changes in the Work may be accomplished after execution of the Contract. The Owner, without invalidating the Contract, may order changes in the Work within the general scope of the Contract consisting of additions, deletions or other revisions, with the Contract Sum and Contract Time being adjusted accordingly. Such changes in the Work shall be authorized by written Change Order signed by the Owner, Contractor and Architect, or by written Construction Change Directive signed by the Owner and Architect.

§ 13.2 Adjustments in the Contract Sum and Contract Time resulting from a change in the Work shall be determined by mutual agreement of the parties or, in the case of a Construction Change Directive signed only by the Owner and Architect, by the Contractor's cost of labor, material, equipment, and reasonable overhead and profit, unless the parties agree on another method for determining the cost or credit. Pending final determination of the total cost of a Construction Change Directive, the Contractor may request payment for Work completed pursuant to the Construction Change Directive. The Architect will make an interim determination of the amount of payment due for purposes of certifying the Contractor's monthly Application for Payment. When the Owner and Contractor agree on adjustments to the Contract Sum and Contract Time arising from a Construction Change Directive, the Architect will prepare a Change Order.

§ 13.3 The Architect will have authority to order minor changes in the Work not involving adjustment in the Contract Sum or extension of the Contract Time and not inconsistent with the intent of the Contract Documents. Such changes shall be effected by written order and shall be binding on the Owner and Contractor. The Contractor shall carry out such written orders promptly.

§ 13.4 If concealed or unknown physical conditions are encountered at the site that differ materially from those indicated in the Contract Documents or from those conditions ordinarily found to exist, the Contract Sum and Contract Time shall be equitably adjusted as mutually agreed between the Owner and Contractor; provided that the Contractor provides notice to the Owner and Architect promptly and before conditions are disturbed. No adjustment in the Contract Time or Contract Sum shall be permitted, however, in connection with a concealed or unknown condition that does not differ materially from those conditions disclosed or that reasonably should have been disclosed by the Contractor's (i) prior inspections, tests, reviews, and preconstruction services for the Project, or (ii) inspections, test, reviews, and preconstruction services that the Contractor had the opportunity to make or should have performed in connection with the Project.

§ 13.5 Except as permitted in Section 13.1, a change in the Contract Sum or the Contract Time shall be accomplished only by Change Order. Accordingly, no course of conduct or dealings between the parties, nor express or implied acceptance of alterations or additions to the Work, and no claim that the Owner has been unjustly enriched by any alteration or addition to the Work, whether or not there is, in fact, any unjust enrichment to the Work, shall be the basis of any claim to an increase in any amounts due under the Contract Documents or a change in any time period provided for in the Contract Documents.

§ 13.6 Agreement on any Change Order shall constitute a final settlement of all matters relating to the change in the Work that is the subject of the Change Order, including, but not limited to, all direct and indirect costs associated with such change and any and all adjustments to the Contract Sum and the construction schedule.

#### ARTICLE 14 TIME

§ 14.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing this Agreement the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

§ 14.2 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

§ 14.3 The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

§ 14.4 The date of Substantial Completion is the date certified by the Architect in accordance with Section 15.4.3.

§ 14.5 If the Contractor is delayed at any time in the commencement or progress of the Work by changes ordered in the Work, by labor disputes, fire, unusual delay in deliveries, abnormal adverse weather conditions not reasonably anticipatable, unavoidable casualties or any causes beyond the Contractor's control, or by other causes which the Architect and Owner jointly determine may justify delay, then the Contract Time shall be extended by Change Order to the extent such delay will prevent the Contractor from achieving Substantial Completion within the Contract Time and if the performance of the Work is not, was not, or would not have been delayed by any other cause for which the Contractor is not entitled to an extension in the Contract Time under the Contract Documents. The Contractor further acknowledges and agrees that adjustments in the Contract Time will be permitted for a delay only to the extent such delay (i) is not caused, or could not have been anticipated, by the Contractor, (ii) could not be limited or avoided by the Contractor's timely notice to the Owner of the delay or reasonable likelihood that a delay will occur, and (iii) is of a duration not less than one (1) day.



§ 14.6 Notwithstanding anything to the contrary in the Contract Documents, an extension in the Contract Time, to the extent permitted under Section 14.5, shall be the sole remedy of the Contractor for any (i) delay in the commencement, prosecution, or completion of the Work, (ii) hindrance or obstruction in the performance of the Work, (iii) loss of productivity, or (iv) other similar claims (collectively referred to in this Section 14.6 as “Delays”), whether or not such Delays are foreseeable, unless a Delay is caused by acts of the Owner constituting active interference with the Contractor’s performance of the Work, and only to the extent such acts continue after the Contractor furnishes the Owner with notice of such interference. In no event shall the Contractor be entitled to any compensation or recovery of any damages, in connection with any Delay, including without limitation consequential damages, lost opportunity costs, impact damages, or other similar remuneration. The Owner’s exercise of any of its rights or remedies under the Contract Documents (including without limitation ordering changes in the Work, or directing suspension, rescheduling, or correction of the Work), regardless of the extent or frequency of the Owner’s exercise of such rights or remedies, shall not be construed as active interference with the Contractor’s performance of the Work.

§ 14.7 If the Contractor submits a progress report indicating, or otherwise expresses an intention to achieve, completion of the Work prior to any completion date required by the Contract Documents or expiration of the Contract Time, no liability of the Owner to the Contractor for any failure of the Contractor to so complete the Work shall be created or implied.

## ARTICLE 15 PAYMENTS AND COMPLETION

### § 15.1 APPLICATIONS FOR PAYMENT

§ 15.1.1 Where the Contract is based on a Stipulated Sum or the Cost of the Work with a Guaranteed Maximum Price, the Contractor shall submit to the Architect, before the first Application for Payment, a schedule of values, allocating the entire Contract Sum to the various portions of the Work, prepared in such form and supported by such data to substantiate its accuracy as the Architect may require. This schedule, unless objected to by the Owner or the Architect, shall be used in reviewing the Contractor’s Applications for Payment.

§ 15.1.2 With each Application for Payment where the Contract Sum is based upon the Cost of the Work, or the Cost of the Work with a Guaranteed Maximum Price, the Contractor shall submit payrolls, petty cash accounts, receipted invoices or invoices with check vouchers attached, and any other evidence required by the Owner to demonstrate that cash disbursements already made by the Contractor on account of the Cost of the Work equal or exceed (1) progress payments already received by the Contractor, less (2) that portion of those payments attributable to the Contractor’s Fee; plus (3) payrolls for the period covered by the present Application for Payment.

§ 15.1.3 Payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment stored, and protected from damage, off the site at a location agreed upon in writing.

§ 15.1.4 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor’s knowledge, information and belief, be free and clear of liens, claims, security interests or other encumbrances adverse to the Owner’s interests.

- .1 The Contractor further expressly undertakes to defend the Indemnitees under Section 9.15 of this Agreement, at the Contractor’s sole expense, against any actions, lawsuits, or proceedings brought against the Indemnitees as a result of liens filed against the Work, the site of any of the Work, the Project site and any improvements thereon, payments due the Contractor, or any portion of the property of any of the Indemnitees (referred to collectively as “liens” in this Subsection 15.1.4). The Contractor hereby agrees to indemnify and hold

- the Indemnitees harmless against any such liens or claims of lien and agrees to pay any judgment or lien resulting from any such actions, lawsuits, or proceedings.
- 2 The Owner shall release any payments withheld due to a lien or claim of lien if the Contractor obtains security acceptable to the Owner or a lien bond that is (i) issued by a surety acceptable to the Owner, (ii) in form and substance satisfactory to the Owner, and (iii) in an amount not less than one hundred fifty percent (150%) of such lien claim. By posting a lien bond or other acceptable security, however, the Contractor shall not be relieved of any responsibilities or to defend and indemnify the Indemnitees. The cost of any premiums incurred in connection with such bonds and security shall be the responsibility of the Contractor and shall not be part of, or cause any adjustment to, the Contract Sum.
  - 3 Notwithstanding the foregoing or any other provision contained herein, Owner reserves the right, at any time and for any reason, to settle any disputed mechanic's or material supplier's lien claim by payments to the lien claimant or by such other means as the Owner, in the Owner's sole discretion, determines is the most economical or advantageous method of settling the dispute. The Contractor shall promptly reimburse the Owner, upon demand, for any payments so made plus any and all fees (including attorneys' fees) incurred by the Owner in connection with its negotiation, payment and/or settlement of any disputed mechanic's or material supplier's liens.

## § 15.2 CERTIFICATES FOR PAYMENT

§ 15.2.1 The Architect will, within ten (10) days after receipt of the Contractor's Application for Payment, either issue to the Owner a Certificate for Payment, with a copy to the Contractor, for such amount as the Architect determines is properly due, or notify the Contractor and Owner in writing of the Architect's reasons for withholding certification in whole or in part as provided in Section 15.2.3.

§ 15.2.2 The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on the Architect's evaluations of the Work and the data comprising the Application for Payment, that, to the best of the Architect's knowledge, information and belief, the Work has progressed to the point indicated and that the quality of the Work is in accordance with the Contract Documents. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion and to specific qualifications expressed by the Architect. The issuance of a Certificate for Payment will further constitute a representation that the Contractor is entitled to payment in the amount certified. However, the issuance of a Certificate for Payment will not be a representation that the Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work, (2) reviewed construction means, methods, techniques, sequences or procedures, (3) reviewed copies of requisitions received from Subcontractors and material suppliers and other data requested by the Owner to substantiate the Contractor's right to payment, or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

§ 15.2.3 The Architect may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Section 15.2.2 cannot be made. If the Architect is unable to certify payment in the amount of the Application, the Architect will notify the Contractor and Owner as provided in Section 15.2.1. If the Contractor and the Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Architect may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Section 9.2.2, because of

- .1 defective Work not remedied;

- .2 third party claims filed or reasonable evidence indicating probable filing of such claims unless security acceptable to the Owner is provided by the Contractor;
- .3 failure of the Contractor to make payments properly to Subcontractors or for labor, materials or equipment;
- .4 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
- .5 damage to the Owner or a separate contractor;
- .6 reasonable evidence that the Work will not be completed within the Contract Time and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay;
- .7 repeated failure to carry out the Work in accordance with the Contract Documents; or
- .8 the absence of any lien releases or waivers required by this Agreement.

§ 15.2.4 When the above reasons for withholding certification are removed, certification will be made for amounts previously withheld.

### § 15.3 PROGRESS PAYMENTS

§ 15.3.1 The Contractor shall pay each Subcontractor, no later than ten (10) days after receipt of payment, the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to sub-subcontractors in similar manner. Notwithstanding anything in this Subsection 15.3.1 to the contrary, the Owner may elect, in the Owner's sole discretion, to make any payment requested by the Contractor on behalf of a Subcontractor of any tier jointly payable to the Contractor and such Subcontractor. The Contractor and such Subcontractor shall be responsible for the allocation and disbursement of the funds included as part of any such joint payment. In no event shall any joint payment be construed to create any (i) contract between the Owner and a Subcontractor of any tier, (ii) obligations from the Owner to such Subcontractor, or (iii) rights in such Subcontractor against the Owner. In addition, the Owner may elect, in its sole discretion, to require that the Contractor make joint payments to each Subcontractor of any tier and their material suppliers.

§ 15.3.2 Neither the Owner nor Architect shall have an obligation to pay or see to the payment of money to a Subcontractor except as may otherwise be required by law.

§ 15.3.3 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

### § 15.4 SUBSTANTIAL COMPLETION

§ 15.4.1 Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use, provided, however, that as a condition precedent to Substantial Completion, the Owner shall have received all permits, approvals, licenses, and other documents (other than a certificate of occupancy which must be delivered as required by Article 2) from any governmental authority having jurisdiction thereof necessary for the beneficial occupancy of the Project.

§ 15.4.2 When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

§ 15.4.3 Upon receipt of the Contractor's list, the Architect will make an inspection to determine whether the Work or designated portion thereof is substantially complete. When the Architect determines that the

Work or designated portion thereof is substantially complete, the Architect will issue a Certificate of Substantial Completion which shall establish the date of Substantial Completion, establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance, and fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

§ 15.4.4 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in such Certificate. Upon such acceptance and consent of surety, if any, the Owner shall make payment of retainage applying to such Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

#### § 15.5 FINAL COMPLETION AND FINAL PAYMENT

§ 15.5.1 Upon receipt of the Contractor's written notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspection and, when the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's on-site visits and inspections, the Work has been completed in accordance with terms and conditions of the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. As a condition precedent to the Contractor receiving final payment, and in addition to any additional requirements set forth herein, including, but not limited to, Section 15.5.2, the Contractor shall also submit to the Architect and the Owner the following:

- (i) all as-built drawings;
- (ii) a complete list of Subcontractors and principal vendors on the Project, including addresses and telephone numbers;
- (iii) an indexed, loose leaf binder containing complete installation, operation, and maintenance manuals, including all manufacturers' literature, of equipment and materials used in the Work;
- (iv) an indexed, loose leaf binder containing all inspection reports, permits, and temporary and final certificates of occupancy and licenses necessary for the occupancy of the Project;
- (v) the following completed and executed AIA documents, each of which must contain all exhibits or attachments required by such documents and each of which must be satisfactory to the Owner: AIA Document G706 - 1994, AIA Document G706A-1994, and AIA Document G707-1994;
- (vi) any and all other items required pursuant to the Contract Documents or reasonably requested by the Owner or the Architect; and
- (vii) one bound and indexed copy, and one electronic and indexed copy, of all submittals made by the Contractor, any Subcontractor, or any other party for which the Contractor is responsible under this Agreement, relating to the Work, the Project, the Contract Documents, or any other matter under this Agreement.

The Architect's final Certificate for Payment will constitute a further representation that conditions stated in Section 15.5.2 as precedent to the Contractor's being entitled to final payment have been fulfilled. All warranties and guarantees required under or pursuant to the Contract Documents shall be assembled and delivered by the Contractor to the Architect as part of the final Application for Payment. The final Certificate for Payment will not be issued by the Architect until all warranties and guarantees have been received and accepted by the Owner.

§ 15.5.2 Final payment shall not become due until the Contractor has delivered to the Owner a complete release of all liens arising out of this Agreement or receipts in full covering all labor, materials and equipment for which a lien could be filed, or a bond satisfactory to the Owner to indemnify the Owner

against such lien. If any lien remains unsatisfied, or is filed, after final payment is made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging such lien, including costs and attorneys' fees. In addition to the foregoing, final payment shall not become due until the Contractor furnishes the Owner with a certificate of occupancy, or equivalent, issued by the local jurisdiction.

§ 15.5.3 The making of final payment shall constitute a waiver of claims by the Owner except those arising from

- .1 liens, claims, security interests or encumbrances arising out of the Contract and unsettled;
- .2 failure of the Work to comply with the requirements of the Contract Documents; or
- .3 terms of special warranties required by the Contract Documents.

§ 15.5.4 Acceptance of final payment by the Contractor, a Subcontractor or material supplier shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

## ARTICLE 16 PROTECTION OF PERSONS AND PROPERTY

### § 16.1 SAFETY PRECAUTIONS AND PROGRAMS

The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the performance of the Contract. The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury or loss to

- .1 employees on the Work and other persons who may be affected thereby;
- .2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody or control of the Contractor or the Contractor's Subcontractors or Sub-subcontractors;
- .3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction; and
- .4 the Contractor shall maintain the site in a safe and clean condition at all times during performance of the Work.

The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities bearing on safety of persons and property and their protection from damage, injury or loss. The Contractor shall promptly remedy damage and loss to property caused in whole or in part by the Contractor, a Subcontractor, a sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 16.1.2 and 16.1.3, except for damage or loss attributable to acts or omissions of the Owner or Architect or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 9.15. When all or a portion of the Work is suspended for any reason, the Contractor shall securely fasten down all coverings and protect the Work, as necessary, from injury by any cause. The Contractor shall promptly report in writing to the Owner and Architect all accidents arising out of or in connection with the Work that cause death, personal injury, or property damage, giving full details and statements of any witnesses. In addition, if death, serious personal injuries, or series damages occur, the accident shall be reported immediately by telephone or messenger to the Owner and the Architect.

### § 16.2 HAZARDOUS MATERIALS

§ 16.2.1 The Contractor is responsible for compliance with the requirements of the Contract Documents regarding hazardous materials. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents, and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a hazardous material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the site by the Contractor,

the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and report the condition to the Owner and Architect in writing. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased in the amount of the Contractor's reasonable additional costs of shutdown, delay and start-up.

#### § 16.2.2 Intentionally Deleted.

§ 16.2.3 If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall indemnify the Contractor for all cost and expense thereby incurred.

### ARTICLE 17 INSURANCE AND BONDS

§ 17.1 The Contractor shall purchase from, and maintain in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located, insurance for protection from claims under workers' compensation acts and other employee benefit acts which are applicable, claims for damages because of bodily injury, including death, and claims for damages, other than to the Work itself, to property which may arise out of or result from the Contractor's operations and completed operations under the Contract, whether such operations be by the Contractor or by a Subcontractor or anyone directly or indirectly employed by any of them. This insurance shall be written for not less than limits of liability specified in the Contract Documents or required by law, whichever coverage is greater, and shall include contractual liability insurance applicable to the Contractor's obligations under Section 9.15. Certificates of Insurance acceptable to the Owner shall be filed with the Owner prior to commencement of the Work. Each policy shall contain a provision that the policy will not be canceled or allowed to expire until at least thirty (30) days' prior written notice has been given to the Owner. The Contractor shall cause the commercial liability coverage required by the Contract Documents to include: (1) the Owner, the Architect and the Architect's Consultants as additional insureds for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's operations; and (2) the Owner as an additional insured for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's completed operations.

§ 17.1.1 The Contractor shall, for the protection and benefit of the Indemnitees and the Contractor and as part of the Contractor's efforts to satisfy the obligations set forth in this Article 17, procure, pay for, and maintain in full force and effect, at all times during the performance of the Work until final acceptance of the Work or for such duration as required, policies of insurance issued by a responsible carrier or carriers acceptable to the Owner, and in form and substance reasonably satisfactory to the Owner, which afford the coverages set forth in the Schedule of Insurance, attached to this Agreement and made a part thereof of as Exhibit C. All such insurance shall be written on an occurrence basis. Information concerning reduction of coverage shall be furnished by the Contractor promptly.

§ 17.1.2 The Contractor hereby agrees to deliver to the Owner, within three (3) days of the date of this Agreement and prior to bringing any equipment or personnel onto the site of the Work or the Project site, certified copies of all insurance policies procured by the Contractor under or pursuant to this Article 17 or, with consent of the Owner, Certificates of Insurance in form and substance satisfactory to the Owner evidencing the required coverages with limits not less than those specified in Exhibit C to this Agreement. The coverage afforded under any insurance policy obtained under or pursuant to this Article 17 shall be primary to any valid and collectible insurance carried separately by any of the Indemnitees. Furthermore, all policies and Certificates of Insurance shall expressly provide that no less than thirty (30) days' prior written notice shall be given the Owner in the event of a material alteration, cancellation, nonrenewal, or expiration of the coverage contained in such policy or evidenced by such certified copy or Certificate of Insurance.

§ 17.1.3 In no event shall any failure of the Owner to receive certified copies of or certificates of policies required under this Article 17 or to demand receipt of such certified copies or certificates prior to the Contractor's commencing the Work be construed as a waiver by the Owner or the Architect of the Contractor's obligations to obtain insurance pursuant to this Article 17. The obligation to procure and maintain any insurance required by this Article 17 is a separate responsibility of the Contractor and independent of the duty to furnish a certified copy or certificate of such insurance policies.

§ 17.1.4 If the Contractor fails to purchase and maintain, or require to be purchased and maintained, any insurance required under this Article 17, the Owner may, but shall not be obligated to, upon ten (10) days' written notice to the Contractor, purchase such insurance on behalf of the Contractor and shall be entitled to be reimbursed by the Contractor upon demand.

§ 17.1.5 When any required insurance shall expire, due to the attainment of a normal expiration date or renewal date, the Contractor shall supply the Owner with Certificates of Insurance and amendatory riders or endorsements that clearly evidence the continuation of all coverage in the same manner, limits of protection, and scope of coverage as was provided by the previous policy. In the event any renewal or replacement policy, for whatever reason obtained or required, is written by a carrier other than that with whom the coverage was previously placed, or the subsequent policy differs in any way from the previous policy, the Contractor shall also furnish the Owner with a certified copy of the renewal or replacement policy unless the Owner provides the Contractor with prior written consent to submit only a Certificate of Insurance for any such policy. All renewal and replacement policies shall be in form and substance satisfactory to the Owner and written by carriers acceptable to the Owner.

§ 17.1.6 Any aggregate limit under the Contractor's liability insurance shall, by endorsement, apply to this Project separately.

§ 17.1.7 The Contractor shall cause each Subcontractor to (i) procure insurance reasonably satisfactory to the Owner, and (ii) name the Indemnitees as additional insureds under the Subcontractor's comprehensive general liability policy. The additional insureds endorsement included on the Subcontractor's comprehensive general liability policy shall state that coverage is afforded the additional insureds with respect to claims arising out of operations performed by or on behalf of the Contractor. If the additional insureds have other insurance that is applicable to the loss, such other insurance shall be on an excess or contingent basis. The amount of the insurer's liability under this policy shall not be reduced by the existence of such other insurance.

## § 17.2 OWNER'S LIABILITY INSURANCE

The Owner shall be responsible for purchasing and maintaining the Owner's usual liability insurance.

## § 17.3 PROPERTY INSURANCE

§ 17.3.1 The Contractor shall purchase and maintain, with a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located, builder's risk property insurance written on a builder's risk "all-risk" or equivalent policy form in the amount of the initial Contract Sum, plus the value of subsequent modifications and cost of materials supplied and installed by others, comprising total value for the entire Project at the site on a replacement cost basis without optional deductibles. Such property insurance shall be maintained, unless otherwise provided in the Contract Documents or otherwise agreed in writing by all persons and entities who are beneficiaries of such insurance, until final payment has been made as provided in Section 15.5 or until no person or entity other than the Owner has an insurable interest in the property required by this Section 17.3.1 to be covered, whichever is later. This insurance shall include interests of the Owner, the Contractor, Subcontractors and sub-subcontractors in the Project. If the property insurance requires deductibles, the Contractor shall pay costs not covered because of such deductibles.

§ 17.3.2 Reserved.

§ 17.3.3 The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents and employees, each of the other, and (2) the Architect, Architect's consultants, separate contractors described in Article 12, if any, and any of their subcontractors, sub-subcontractors, agents and employees for damages caused by fire or other causes of loss to the extent of actual recovery of any insurance proceeds under any property insurance obtained pursuant to Section 17.3 or other property insurance applicable to the Work. The Owner or Contractor, as appropriate, shall require of the Architect, Architect's consultants, separate contractors described in Article 12, if any, and the subcontractors, sub-subcontractors, agents and employees of any of them, by appropriate agreements, written where legally required for validity, similar waivers each in favor of other parties enumerated herein. The policies shall provide such waivers of subrogation by endorsement or otherwise. A waiver of subrogation shall be effective as to a person or entity even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, did not pay the insurance premium directly or indirectly, and whether or not the person or entity had an insurable interest in the property damaged.

§ 17.3.4 A loss insured under the Owner's property insurance, if any is required to be maintained under this Agreement, shall be adjusted by the Owner as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause. The Contractor shall pay Subcontractors their just shares of insurance proceeds received by the Contractor, and by appropriate agreements, written where legally required for validity, shall require Subcontractors to make payments to their sub-subcontractors in similar manner.

#### § 17.4 PERFORMANCE BOND AND PAYMENT BOND

§ 17.4.1 The Contractor shall furnish bonds to the Owner covering faithful performance of the Contract and payment of obligations arising thereunder as stipulated in bidding requirements or specifically required in the Contract Documents on the date of execution of the Contract. Such bonds shall also cover unpaid mechanic's liens for a period of six (6) months following Final Payment.

§ 17.4.2 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished.

#### § 17.5 GENERAL REQUIREMENTS

§ 17.5.1 All insurance coverage procured by the Contractor shall be provided by insurance companies having policy holder ratings no lower than "A" and financial ratings no lower than "XII" in the *Best's Insurance Guide*, latest edition in effect as of the date of the Contract, and subsequently in effect at the time of renewal of any policies required by the Contract Documents.

§ 17.5.2 If the Owner or the Contractor is damaged by the failure of the other party to purchase or maintain insurance required under Article 17, then the party who failed to purchase or maintain the insurance shall bear all reasonable costs (including attorneys' fees and court and settlement expenses) properly attributable thereto.

#### ARTICLE 18 CORRECTION OF WORK

§ 18.1 The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, whether discovered before or after Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Architect's services and expenses made necessary thereby, shall be at the Contractor's expense, unless compensable under Section A.2.7.3 in Exhibit A, Determination of the Cost of the Work. If prior to the date of Substantial Completion, the Contractor, a Subcontractor, or anyone for whom either is responsible uses or damages any portion of the Work, including, without limitation, mechanical, electrical, plumbing, and other building systems, machinery, equipment, or other mechanical device, the Contractor shall cause such



item to be restored to “like new” condition at no expense to the Owner. In addition, the Contractor shall promptly remedy damage and loss arising in conjunction with the Project caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or anyone for whose acts they may be liable and for which the Contractor is responsible.

§ 18.2 In addition to the Contractor’s obligations under Section 9.4, if, within one year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 15.4.3, or by terms of an applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of written notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor. The Contractor agrees to (i) send an authorized employee to the Project within five (5) business days after being notified that a correction to the Work, or any designated portion thereof, is required to discuss the correction with designated representatives of the Owner, and (ii) make any required correction to the Work, or designated portion thereof, within fifteen (15) days after it receives the correction notice from the Owner.

§ 18.3 If the Contractor fails to correct nonconforming Work within a reasonable time, the Owner may correct it in accordance with Section 8.3.

§ 18.4 The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

§ 18.5 Upon completion of any Work under or pursuant to this Article 18, the one-year correction period in connection with the Work requiring correction shall be renewed and recommence. The obligations under this Article 18 shall cover any repairs and replacement to any part of the Work or other property caused by the defective Work.

§ 18.6 In addition to the other provisions of this Article 18, the Contractor agrees to visit, inspect and, to the extent necessary, make any corrections to the Project at the following intervals: (i) once between the third and sixth month following the final completion of the Work, and (ii) once on or about the first yearly anniversary of the final completion of the Work. In each case, the Contractor will provide prior written notice to the Owner of such visit, inspection and, if necessary, corrections and will, if requested by the Owner, make such adjustments to the Contractor’s schedule as required by the Owner.

## ARTICLE 19 MISCELLANEOUS PROVISIONS

### § 19.1 ASSIGNMENT OF CONTRACT

Except as expressly provided in the Contract Documents, neither party to the Contract shall assign the Contract without written consent of the other, except that the Owner may, without consent of the Contractor, assign the Contract to a lender providing construction financing for the Project if the lender assumes the Owner’s rights and obligations under the Contract Documents. The Contractor shall execute all consents reasonably required to facilitate such assignment. The Contractor shall also not enter into any subcontracts or purchase orders without the written consent of the Owner.

### § 19.2 GOVERNING LAW

The Contract shall be governed by the law of the Commonwealth of Virginia (without regard to such jurisdiction’s choice of law rules), except (i) that if the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 21.4, or (ii) as otherwise set forth herein.

### § 19.3 TESTS AND INSPECTIONS

Tests, inspections and approvals of portions of the Work required by the Contract Documents or by applicable laws, statutes, ordinances, codes, rules and regulations or lawful orders of public authorities shall be made at an appropriate time. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections and approvals. The Contractor shall give the Architect timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures. The Owner shall bear costs of (1) tests, inspections or approvals that do not become requirements until after bids are received or negotiations concluded, and (2) tests, inspections or approvals where building codes or applicable laws or regulations prohibit the Owner from delegating the costs to the Contractor.

### § 19.4 COMMENCEMENT OF STATUTORY LIMITATION PERIOD

The Owner and Contractor shall commence all claims and causes of action, whether in contract, tort, breach of warranty or otherwise, against the other arising out of or related to the Contract in accordance with the requirements of the final dispute resolution method selected in this Agreement within the period specified by applicable law, but in any case not more than 10 years after the date of Substantial Completion of the Work. The Owner and Contractor waive all claims and causes of action not commenced in accordance with this Section 19.4.

### § 19.5 NOTICES

All notices to be provided under this Agreement shall be in writing. Written notice shall be deemed to have been duly served if delivered in person to the individual or member of the firm or entity for whom it was intended, or if delivered at or sent by registered or certified mail to the following addresses:

If to the Contractor:

If to the Owner: Navy Federal Credit Union  
820 Follin Lane  
Vienna, Virginia 22180  
Attn: AVP-BOFM

Copies to: Hunton & Williams LLP  
1751 Pinnacle Drive, Suite 1700  
McLean, Virginia 22102  
Attn: Brian Tanenbaum, Esq.

If to the Architect:

Notice shall be deemed effective (i) upon delivery, if personally delivered; (ii) upon one (1) business day following deposit with a national overnight courier service, fee prepaid; or (iii) upon two (2) business days following deposit in the United States mail, certified or registered mail, postage prepaid, return receipt requested.

### § 19.6 PUNCH LIST PROCEDURES

§ 19.6.1 Promptly after the date of Substantial Completion the Contractor, the Architect and the Owner shall perform a walk-through inspection of the Work and, within five (5) days after such inspection, the Contractor shall furnish an accounting ("Punch List") of all items noted as needing adjustment, repair or replacement ("Punch List Items"). All work by the Contractor to address the Punch List Items must be completed by the Punch List Completion Date.

§ 19.6.2 Within five (5) days following notice from the Contractor that all Punch List Items have been addressed, the Owner and/or the Architect shall verify that such Punch List Items have been adequately addressed. In the event that all Punch List Items have been adequately addressed by the Contractor, the Owner or the Architect shall execute a “Punch List Close-Out” indicating that there are no outstanding Punch List Items.

## ARTICLE 20 TERMINATION OF THE CONTRACT

### § 20.1 TERMINATION BY THE CONTRACTOR

If the Architect fails to certify payment as provided in Section 15.2.1 for a period of thirty (30) days through no fault of the Contractor, or if the Owner fails to make payment as provided in Section 4.1.3 for a period of sixty-five (65) days, the Contractor may, upon fifteen (15) additional days’ written notice to the Owner and the Architect, terminate the Contract and recover from the Owner payment for Work executed, including reasonable overhead and profit, costs incurred by reason of such termination, and damages.

### § 20.2 TERMINATION BY THE OWNER FOR CAUSE

§ 20.2.1 The Owner may terminate the Contract if the Contractor

- .1 repeatedly refuses or fails to supply enough properly skilled workers or proper materials;
- .2 fails to make payment to Subcontractors for materials or labor in accordance with the respective agreements between the Contractor and the Subcontractors;
- .3 repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations or lawful orders of a public authority; or
- .4 is otherwise guilty of substantial breach of a provision of the Contract Documents.

§ 20.2.2 When any of the above reasons exists, the Owner, upon certification by the Architect that sufficient cause exists to justify such action, may, without prejudice to any other remedy the Owner may have and after giving the Contractor thirty (30) days’ written notice, terminate the Contract and take possession of the site and of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor and may finish the Work by whatever reasonable method the Owner may deem expedient. Upon request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

§ 20.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 20.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 20.2.4 If the unpaid balance of the Contract Sum is less than all costs of finishing the Work, including compensation for the Architect’s and the Owner’s representative’s services and expenses made necessary thereby, the Contractor shall pay the difference to the Owner. If the unpaid balance of the Contract Sum is greater than all costs of finishing the Work, including compensation for the services and expenses of the Architect and the Owner’s representative made necessary thereby, the Contractor shall receive payment for Work properly performed by the Contractor for which payment was not made previously; any excess amounts shall be retained by the Owner. This Section 20.2.4 shall survive termination of the Contract.

### § 20.3 TERMINATION BY THE OWNER FOR CONVENIENCE

The Owner may, at any time, terminate the Contract for the Owner’s convenience and without cause.

§ 20.3.1 Upon receipt of written notice from the Owner of such termination for the Owner’s convenience, the Contractor shall:

- .1 cease operations as directed by the Owner in the notice;
- .2 take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and
- .3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

§ 20.3.2 Upon such termination, the Contractor shall recover as its sole remedy payment for Work properly performed in connection with the terminated portion of the Work prior to the effective date of termination and for items properly and timely fabricated off the Project site, delivered, and stored in accordance with the Owner's instructions. The Contractor hereby waives and forfeits all other claims for payment and damages, including, without limitation, anticipated profits. Owner shall be credited for (i) payments previously made to the Contractor for the terminated portion of the Work, (ii) claims that the Owner has against the Contractor under the Contract, and (iii) the value of the materials, supplies, equipment, or other items that are to be disposed of by the Contractor that are part of the Contract Sum.

## ARTICLE 21 CLAIMS AND DISPUTES

§ 21.1 Claims, disputes and other matters in question arising out of or relating to this Contract, but excluding those arising under Section 16.2, and those waived as provided for in Sections 15.5.3 and 15.5.4, shall be subject to mediation as a condition precedent to binding dispute resolution.

§ 21.2 If a claim, dispute or other matter in question relates to or is the subject of a mechanic's lien, the party asserting such matter may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.

§ 21.3 The parties shall endeavor to resolve their disputes by mediation which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with their Construction Industry Mediation Procedures in effect on the date of the Agreement. A request for mediation shall be made in writing, delivered to the other party to this Agreement, and filed with the person or entity administering the mediation. The request may be made concurrently with the binding dispute resolution but, in such event, mediation shall proceed in advance of binding dispute resolution proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order. If an arbitration is stayed pursuant to this Section, the parties may nonetheless proceed to the selection of the arbitrator(s) and agree upon a schedule for later proceedings.

§ 21.4 If the parties have selected arbitration as the method for binding dispute resolution in the Agreement, any claim, subject to, but not resolved by, mediation shall be subject to arbitration which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association, in accordance with the Construction Industry Arbitration Rules in effect on the date of this Agreement. Demand for arbitration shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the arbitration. The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

§ 21.5 Either party, at its sole discretion, may consolidate an arbitration conducted under this Agreement with any other arbitration to which it is a party provided that (1) the arbitration agreement governing the other arbitration permits consolidation; (2) the arbitrations to be consolidated substantially involve common questions of law or fact; and (3) the arbitrations employ materially similar procedural rules and methods for selecting arbitrator(s).

§ 21.6 Any party to an arbitration may include by joinder persons or entities substantially involved in a common question of law or fact whose presence is required if complete relief is to be accorded in arbitration provided that the party sought to be joined consents in writing to such joinder. Consent to arbitration involving an additional person or entity shall not constitute consent to arbitration of a Claim not described in the written Consent.

§ 21.7 The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

§ 21.8 The parties agree that the forum for any mediation, arbitration or other dispute resolution procedure under this Agreement will take place in a mutually agreeable location in Fairfax County, Virginia.

§ 21.9 Intentionally deleted.

## ARTICLE 22 OTHER CONDITIONS AND PROVISIONS

§ 22.1 All personal pronouns used in this Agreement, whether used in the masculine, feminine, or neuter gender, shall include all other genders; and the singular shall include the plural and vice versa. Titles of articles, sections, and subsections are for convenience only and neither limit nor amplify the provisions of this Agreement. The use herein of the word “including,” when following any general statement, term, or matter, shall not be construed to limit such statement, term, or matter to the specific items or matters set forth immediately following such word or to similar items or matters, whether or not non-limiting language (such words as “without limitation,” “but not limited to,” or words of similar import) is used with reference thereto, but rather shall be deemed to refer to all other items or matters that could reasonably fall within the broadest possible scope of such general statement, term, or matter.

§ 22.2 Wherever possible, each provision of this Agreement shall be interpreted in a manner as to be effective and valid under applicable law. If, however, any provision of this Agreement, or portion thereof, is prohibited by law or found invalid under any law, only such provision or portion thereof shall be ineffective, without in any manner invalidating or affecting the remaining provisions of this Agreement or valid portions of such provision, which are hereby deemed to be severable.

§ 22.3 Each party hereto agrees to do all acts and things and to make, execute, and deliver such written instruments as shall from time to time be reasonably required to carry out the terms and provisions of the Contract Documents.

§ 22.4 Any specific requirement in this Agreement that the responsibilities or obligations of the Contractor also apply to a Subcontractor is added for emphasis and is also hereby deemed to include a Subcontractor of any tier. The omission of a reference to a Subcontractor in connection with any of the Contractor’s responsibilities or obligations shall not be construed to diminish, abrogate, or limit any responsibilities or obligations of a Subcontractor of any tier under the Contract Documents or the applicable subcontract.

§ 22.5 The provisions of the Contract Documents shall not be changed, amended, waived or otherwise modified in any respect except by a writing signed by the Owner. No person is authorized on behalf of the Owner to orally change, amend, waive, or otherwise modify the terms of the Contract Documents or any of the Contractor’s duties or obligations under or arising out of the Contract Documents. Any change waiver, approval, or consent granted to the Contractor shall be limited to the specific matters stated in the writing signed by the Owner, and shall not relieve the Contractor of any other duties or obligations under the Contract Documents. No “constructive” changes shall be allowed.

§ 22.6 The Contractor shall provide all notices required or permitted by the laws of the state in which the Project is located for protection of the Owner from liens and claims of lien if permitted or required by applicable law. The Contractor shall be responsible for filing in the appropriate court or other governmental office records all such notices as required or permitted by the laws of the state in which the Project is located. The Contractor shall provide the Owner with copies of all notices received by the Contractor from subcontractors, sub-subcontractors, and/or suppliers to Contractor.

This Agreement entered into as of the day and year first written above.

\_\_\_\_\_  
OWNER (Signature)  
\_\_\_\_\_  
(Printed name and title)

\_\_\_\_\_  
CONTRACTOR (Signature)  
\_\_\_\_\_  
(Printed name and title)



## **EXHIBIT C TO AIA CONTRACT DOCUMENT AIA A107-2007**

At Contractor's sole cost and expense, Contractor shall procure the following types of insurance coverages at the minimum levels specified and shall maintain the same throughout the performance of the Work. Contractor shall notify Owner in writing with no less than thirty (30) days advance notice of any change or cancellation in the types or levels provided.

- Commercial General Liability Insurance per occurrence, with a combined single limit of Bodily Injury and Property Damage of \$1,000,000 per occurrence and \$2,000,000 general aggregate. Such insurance shall include contractual liability, advertising liability and personal injury coverage;
- Commercial Automobile Liability Insurance including all owned, leased, hired and non-owned vehicles, with a combined single limit for Bodily Injury and Property Damage of \$1,000,000 per occurrence;
- Commercial Umbrella Liability Insurance with per occurrence and aggregate limits of \$2,000,000 in excess coverage over the liability coverage required in other specified lines of coverage herein;
- Workers Compensation Insurance, Coverage A – statutory limits covering all employees in the state in which the services will be provided; Employer's Liability Insurance, Coverage B - with limits for bodily injury by accident of \$1,000,000 per employee and bodily injury by disease of \$1,000,000 policy limit;
- Commercial Crime Insurance covering employee theft and dishonesty with limits of \$1,000,000 per occurrence;
- Errors & Omission Liability Insurance with per occurrence and aggregate limits of \$1,000,000;
- Property Insurance valued at replacement cost covering (Contractor's) real and personal property (such insurance to include business interruption and extra expense)
- Builder's Risk Insurance from a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located, in the amount of the initial Contract Sum, plus the value of subsequent modifications and cost of materials supplied and installed by others, comprising the total value for the entire Project at the site on a replacement cost basis without optional deductibles.

Contractor shall indicate their agreement to and compliance with these requirements at all times during the performance of the work by execution of this AIA A107 Contract Document.

# REPORT FOUNDATION INVESTIGATION

## PROPOSED BANKING FACILITY WESTWORTH VILLAGE, TARRANT COUNTY, TEXAS


### ***PREPARED FOR***

NAVAL FEDERAL CREDIT UNION  
820 FOLLIN LANE  
VIENNA, VIRGINIA 22180

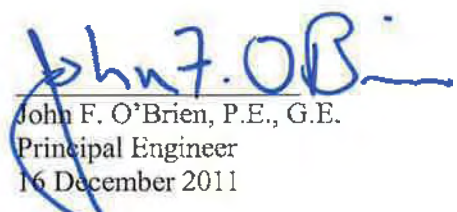
June 2008  
Revised December 2011

URS FILE NO. 15252306

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16 December 2011



  
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16 December 2011



**REPORT**  
**FOUNDATION INVESTIGATION**  
**PROPOSED BANKING FACILITY**  
**WESTWORTH VILLAGE, TARRANT COUNTY, TEXAS**

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## APPENDICES

Appendix A	Figures
Appendix B	Soil Boring Logs
Appendix C	Laboratory Testing Results

**REPORT  
FOUNDATION INVESTIGATION  
PROPOSED BANKING FACILITY  
WESTWORTH VILLAGE, TARRANT COUNTY, TEXAS**

---

## **1 INTRODUCTION**

### **1.1 Terms of Reference**

Navy Federal Credit Union (NFCU) plans to develop a single story branch banking facility and related infrastructure at an undeveloped site in Westworth Village, Tarrant County, Texas. The site location is shown on Figure 1 in Appendix A. This report presents the findings of a foundation investigation completed by URS Corporation (URS), Texas Registered Engineering Firm F-3162, for the development.

The work reported herein was undertaken in accordance with URS' proposal authorized by NFCU. This report was prepared by Messrs. Robert E. Taunton and John F. O'Brien, P.E., G.E. of URS. The report was reviewed by Messrs. Jeffrey F. Rouleau, P.E. and Charles E. Crowell, Jr., P.E., also of URS, in accordance with the requirements of the project for such review.

This report was first submitted in June 2008. Design was initiated 2011, generating several questions regarding geotechnical-related recommendations for site development. This revised report is submitted in order to adapt the report to current planning for development of the proposed single story branch banking facility.

### **1.2 Proposed Development**

NFCU plans to develop a single story banking facility on an approximately 2.014-acre site located immediately southwest of the intersection of State Highway 183 and White Settlement Road in Westworth Village, Tarrant County, Texas. The facility will be a branch operation of NFCU providing the scope of commercial banking services offered by NFCU, including banking, ATM, and drive up banking.

The principal structure will be a 3,500 square foot (sf) single story banking building with a canopied three lane "drive-thru". The principal infrastructure will be about 70 spaces of at grade parking. A stormwater detention pond will be developed in the northeast corner of the site.

The site is heavily treed and currently undeveloped. Topography is relatively level, with a small dry creek bed traversing the terrain, such that the site is somewhat 'bowl'-shaped. Earthwork related to site development will include cuts and fills. Cuts will be typically four feet or less. Fills may range to perhaps nine feet. Any fill should be placed according to the specifications provided herein. The finished floor elevation is anticipated to be about two feet above the highest existing grade elevation.

Beyond utilities, no below grade construction is planned. By virtue of the relatively flat site and limited development, current planning does not propose the use of retaining walls or related earth structures.

### **1.3 Objective, Scope and Limitations of This Work**

#### *1.3.1 Objective*

The objective of the work described herein was to identify subsurface conditions at the site and develop recommendations for foundations and pavements.

#### *1.3.2 Scope*

In order to accomplish the objective of this work, URS undertook the following scope of work:

- drilling and sampling of three (3) geotechnical engineering borings around the perimeter of the site during a feasibility level investigation in January 2007;
- drilling and sampling of three (3) geotechnical engineering borings within the building footprint and in the parking area during the final geotechnical investigation conducted after site access was obtained by NFCU and a tree clearing permit was obtained from the City of Westworth Village;
- laboratory testing intended to characterize the types, strength and compressibility of the subsurface materials; and
- engineering evaluations to determine foundation and site development requirements appropriate to the subsurface conditions.

#### *1.3.3 Limitations*

The scope of URS' services is limited to the geotechnical considerations identified above. These services do not address technical considerations sometimes associated with site development similar to that planned by NFCU, to include:

- matters related to environmental or cultural resources, to include those related to wetlands, archaeology, hazardous materials, surface water, regulated materials, etc;
- zoning, planning, or other requirements for regulatory or civic approvals or variances;
- compliance of the design with codes and ordinances;
- the quality or content of construction specifications resulting from recommendations provided herein;
- the schedule for construction or the schedule-based coordination of this work with other construction;
- health and safety in construction; and
- responsibilities of NFCU, the Designer, and/or the Contractor during and following design and construction.

Use of this report is subject also to the requirements for review of designs and related decision-making resulting from this report, as is described in detail in Section 8. The reader's attention is specifically drawn to these requirements, as it is considered essential that they be followed for the proper use and interpretation of this report.

## 2 FIELD EXPLORATION AND LABORATORY TESTING

### 2.1 Field Exploration

#### 2.1.1 Soil Borings

The field exploration program was conducted in two stages; first as a feasibility investigation on January 26, 2007, then a final geotechnical investigation on June 4, 2008. URS retained local specialty contractors to provide and operate a truck-mounted drill rig. Three (3) soil borings were advanced to a depth of approximately 20 feet below ground surface (bgs) around the perimeter of the site (January 2007). Three (3) soil borings were advanced to depths of approximately 18 to 20 feet bgs within the limits of the proposed building footprint and parking area (June 2008). These soil borings were advanced after tree clearing activities were conducted.

The drilling was completed using solid stem auger and hollow stem auger drilling methods in general accordance with ASTM D1452 (Standard Practice for Soil Investigation and Sampling by Auger Borings). The soil boring locations are shown on Figure 2 in Appendix A. Soil borings logs are provided in Appendix B.

#### 2.1.2 Sampling

Sampling of soils was undertaken as listed below.

1. **Undisturbed Sampling:** Cohesive (clayey and silty) soils were sampled using (i) a 3-inch diameter, thin-walled, seamless Shelby tube sampler advanced hydraulically to obtain relatively undisturbed samples after ASTM D1587 (Standard Practice for Thin Walled Tube Sampling of Soils), and (ii) a split spoon sampler to recover disturbed samples for inspection and index testing using the SPT test (described below). The thin wall sampling provided relatively undisturbed samples of soils for testing to directly evaluate strength and compressibility.
2. **Disturbed Sampling:** Non-cohesive (sandy) soils were sampled by driving a 2-inch o.d. split spoon sampler after ASTM D1586, the Standard Penetration Test ('SPT') (Standard Method for Penetration Test and Split Barrel Sampling of Soils). This sampling method is of primary utility in providing an *in situ* indication of the strength of the soil. As a consequence of the manner by which the test is completed (pounding the sampler into the ground), soil samples are "disturbed" and are used for visual classification and index testing to provide indirect indications of the characteristics of the soils.

All samples were extruded in the field, visually classified, and secured. Undisturbed samples were wrapped in saran wrap and aluminum foil, and placed in wax coated core boxes for transportation to the geotechnical laboratory. Methods of sample preservation and transport were completed in general conformance with ASTM D4220 (Standard Practices for Preserving and Transporting Soil Samples).

## 2.2 Laboratory Testing

### 2.2.1 Scope of the Laboratory Testing

Soil samples were received at the laboratory, opened and visually classified in accordance with American Society of Testing and Materials (ASTM) Method D 2488 (Standard Practice for Description and Identification of Soils [Visual Manual Procedure]).

Laboratory testing commenced following visual classification of the soils. The table below summarizes the testing that was undertaken. Records of individual tests are provided in Appendix C.

**Summary of Laboratory Testing**

Type of Test	Geotechnical Test	Methodology Reference	Number of Tests
Index	Atterberg Limits	ASTM D 4318	5
	Moisture Content	ASTM D 2216	29
	Gradation	ASTM D 422	3
Strength and Compressibility	Unconfined Compression	ASTM D2166	7

**Note:**

Testing methodology is with reference to ASTM Annual Book of ASTM Standards. Section 4. Construction, Volume 04.08, Soil and Rock, Building Stones, latest edition.

### 2.2.2 Indications of the Index Testing

The table below provides a summary of the results of the index testing. Records of individual tests are provided in Appendix C.

**Summary of Index the Testing**

Boring Ref.	Depth (feet, bgs)	Atterberg Limits and Moisture		
		Liquid Limit	Plasticity Index	Moisture Content (%)
SB-1	4-6	56	33	21
SB-2	2-4	43	24	14
SB-3	4-6	34	19	11
SB-2A	13-15	53	31	25
SB-3A	8-10	54	32	16

**Note:**

1. Testing methodology is with reference to ASTM Annual Book of ASTM Standards. Section 4. Construction, Volume 04.08, Soil and Rock, Building Stones, latest edition.
2. 'bgs' indicates 'below ground surface'

“Index tests” or “physical properties tests” are undertaken to provide indirect information about engineering properties of soils, correlating “index properties” (e.g., moisture content, particle size distribution, density, liquidity, etc) with known mechanical characteristics (e.g., strength, compressibility, etc). An indirect approach is taken to avoid the expense, detail, and precision required for specific testing to determine engineering properties, an action that is usually uneconomic in support of geotechnical investigations for smaller structures. The assumption of index testing is that soils with similar index properties, will exhibit similar engineering properties within a limited area. Data secured from index tests, together with descriptions of visual observations and experience with similar soils in an area, are often sufficient for design purposes for smaller structures, such as the subject facility. The most widely used index tests are gradation analyses (ASTM D 422, determination of the range of soil particle sizes that make up the soil matrix) and Atterberg limits (ASTM D 4318, determination of the effect of changes in moisture content to the consistency of clayey soils)

The potential volume change of expansive soils in the western U.S. was first linked to clay content and plasticity index by Holtz and Gibbs in 1956. “Plasticity” is the most commonly used indicator of soils with expansive potential. The Atterberg limits, which include liquid limit (LL), plastic limit (PL) and plasticity index (PI), define moisture content boundaries between states of consistency in soils. Liquid limit is the moisture content at which a soil begins to ‘flow;’ i.e., the highest moisture a soil can hold and act as a solid. The plastic limit is the moisture content at which a soil stiffens from a plastic to a semi-rigid and friable state; the least amount of moisture a soil can hold and remain in a plastic state. PI is the numerical difference between the liquid limit and plastic limit. Testing to determine a soil’s potential plasticity and is widely used in engineering classification systems beyond identification of expansion potential.

**Corps of Engineers Classification of Potential Swell**

<b>Classification of Swell Potential</b>	<b>Potential Swell, S<sub>p</sub> (percent)</b>	<b>Liquid Limit, LL (percent)</b>	<b>Plasticity Index, PI (percent)</b>
Low	< 0.5	< 50	< 25
Moderate	0.5 – 1.5	50 – 60	25 - 35
High	> 1.5	> 60	> 35

**Notes:**

1. LL and PI determined after ASTM D 4318.
2. Potential Swell represents the percent increase in the vertical dimension or the percent potential vertical heave.
3. Source: Department of the Army, Technical Manual TM 5-818-7, *Foundations in Expansive Soils*, 1 September 1983.”

As may be seen by review of the results of the liquidity testing tabulated above, the soils at this site may be considered to have moderate to high expansive potential by comparison to the Corps of Engineers criteria. As such, URS estimates the upper 10 feet of the soils- soils within the “active zone” (the ‘active zone’ is described in Section 4) have the potential to expand vertically by about two to three inches.

Plasticity characteristics and volume change behavior of soils are theorized to be directly related to the amount of colloidal particles (< 1 μm) in soils. For this reason, Atterberg limits and clay content have been combined into a single parameter called the Activity Ratio (A) developed by Skempton (1953). The activity ratio, sometimes called the activity index, is defined as follows:

$$\text{Activity Ratio (A)} = \frac{\text{Plasticity index}}{\% \text{ clay}}$$

Skempton proposed three classes of clays according to the activity ratio as follows:

<u>Relative Activity</u>	<u>Activity Ratio</u>
'inactive'	< 0.75,
'normal'	0.75 to 1.25,
'active'	> 1.25.

Active clays provide the most potential for expansion. The soils at this site may be expected to have about 10 percent to 20 percent clay sized particles (i.e., soil particles less than 5 µm). As may be seen by review of the results of the liquidity testing tabulated above, the soils at this site may be considered to be active clays by comparison to Skempton's criteria.

### 2.2.3 Indications of the Strength Testing

Understanding the strength of the site soils is an important consideration in evaluation of foundation alternatives. The suitability of the clayey soils of this region for foundation support are best described in terms of unconfined compressive strength.

The table below provides the results of the testing. Records of individual tests are provided in Appendix C.

**Summary of Strength Testing**

<b>Boring Ref.</b>	<b>Depth (feet, bgs)</b>	<b>Unconfined Compressive Strength (tsf)</b>
SB-1	2-4	1.40
SB-1	6-8	2.70
SB-2	2-4	2.38
SB-1A	4-6	6.13
SB-2A	13-15	1.10
SB-3A	6-8	4.29
SB-3A	8-10	6.11

**Notes:**

1. Testing methodology is ASTM D 2166.
2. 'tsf' indicates 'tons per square foot' (1 ton = 2,000 pounds).



### 3 SITE AND SUBSURFACE CONDITIONS

#### 3.1 Regional Geology

The site and vicinity are underlain by fluvial terrace deposits, comprised of gravel, sand, silt, and clay and by the Goodland Limestone formation. This formation is very coarsely nodular, containing few thin clay beds and numerous massive resistant limestone beds.

#### 3.2 Site Conditions

##### 3.2.1 Surface

The relatively level 2.014 acre site is heavily treed and presently undeveloped. The ground surface is about elevation +605 feet mean sea level.

To the knowledge of URS, the property has never been developed in any capacity. The graphic on the following page provides an aerial view of the site that is representative of the current condition of the site.

##### 3.2.2 Subsurface

The Soil Survey of Tarrant County, Texas (U.S. Department of Agriculture, Soil Conservation Service) indicates that the site is part of the Bastil-Urban and Sanger-Urban land complexes that are made up of deep and nearly level and gently sloping soils. The typical soil profile for Bastil soils consists of pale brown sandy loam underlain by yellowish red sandy clay loam. The Sanger soils are typically comprised of dark grayish brown clay, which overlies brownish silty clay with common masses of calcium carbonate and limestone fragments.

Both soil types are well drained and have high available water capacity. Soil runoff is medium, and their hazard of erosion is moderate. And while the Bastil soil's permeability is moderate, the Sanger soil's permeability is very slow.

The expansive nature of the clay has important implications for the site. The nature of these soils is discussed in more detail in Section 4.

##### 3.2.3 Groundwater

Groundwater was encountered at depth of approximately 15 to 18 feet below ground surface (bgs), at the time of drilling.

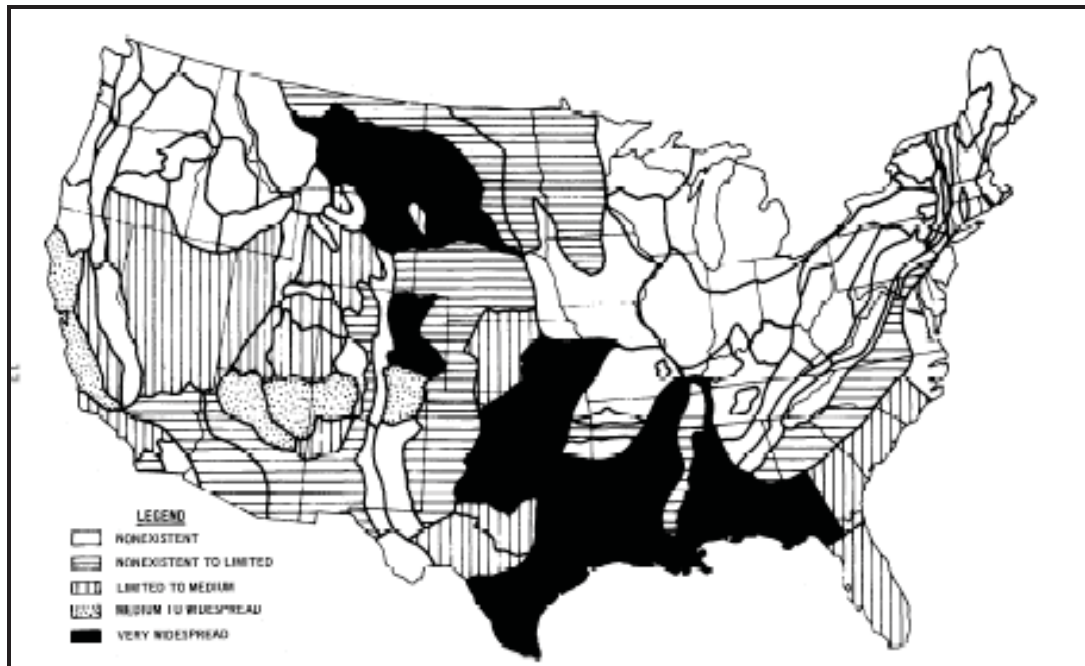


**Aerial View of the Site**  
(Source: Google Earth, 2006)

## 4 BACKGROUND REGARDING EXPANSIVE SOILS

### 4.1 Overview

Clays that tend to swell or shrink due to changes in moisture content are commonly known as expansive soils.<sup>1</sup> Expansive soils are common in those areas underlain by sedimentary rock containing expansive clay minerals, or in areas underlain by colluvial and alluvial deposits derived from those rocks.



**Distribution of Expansive Soils in the United States**

(Source, Witczak, M. W., 1972)

Expansive clays not only ‘expand,’ they also ‘contract;’ i.e., they undergo significant volume change with changes in moisture content (i.e., on wetting or drying). In the field, expansive clay soils can be easily recognized in the dry season by deep, polygonal crack patterns at the ground surface. While the zone of seasonal moisture content fluctuation can extend to several tens of feet depth, the volume change behavior typically occurs in the upper 3-10 feet below the ground surface. There have been instances of deep-seated heave, but these are rare.

The behavior of expansive soils becomes of economic importance when they affect the performance of engineering structures that are founded on them. Expansion and contraction of these soils can cause

<sup>1</sup> All clays shrink and expand with changes in moisture content. Expansive clays are those that undergo considerable such volume change. The 2006 International Building Code (Section 1802.3.2) describes expansive soils as those that meet the following criteria:

1. Plasticity Index (PI) of 15 or greater, after ASTM D 4318.
2. More than 10 percent of the soil particles pass a U. S. No. 200 sieve (74 $\mu$ m), after ASTM D 422, the point of distinction between silts and clays.
3. More than 10 percent of the soil particles are less than 5 microns ( $\mu$ m) in size, determined in accordance with ASTM D 422.

structural damage to rigid materials, such as foundations, pipes, and swimming pools sitting on or buried in the expansive soils. As a natural phenomenon in the U.S., expansive soils are typically the source of more property damage than earthquakes, landslides, tornados and hurricanes combined. The billions of dollars of damage each year in the United States by expansive soils is second only to insect damage.



**Cracking Pattern in a Dry, Expansive Soil**  
(Source: <http://soils.ag.uidaho.edu/soilorders/>)

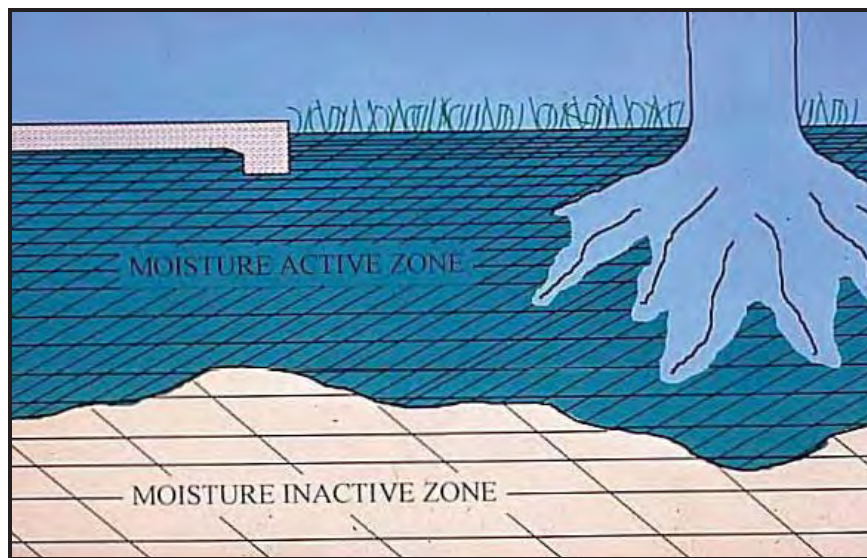


**Soil cut showing the depth of cracking  
(about two feet) in an expansive soil**

(Source: <http://soils.usda.gov/technical/classification/orders/vertisols.html>)

## 4.2 The Depth of Potentially Expansive Soils

Evaluations of the potential for movement of expansive soils consider the extent of the “active zone;” i.e., the soil under and around a structure or pavement that will both be appreciably affected by the presence of the structure, its related appurtenances (landscaping, drainage, etc), development ( most significantly, removal of trees), and the effects of nearby buildings. Absent the existence of civil development on a site, the natural factors of vegetation and climatic variations affect the extent of the “active zone.” Trees have a significant effect on the active zone. As may be seen from the graphic below, the root system affects moisture in the soil, deepening the active zone. Trees near buildings draw water from beneath foundations, creating soil shrinkage. If trees are removed from a building area just prior to construction, their absence can lead to soil expansion as the demand for water is lost.



**The Active Zone, Showing the Effects Tree Roots**

(Source: Foundation Performance Association, Houston, Texas, December 2006)

The active zone in expansive soils can extend to 30 feet as a consequence of a variety of factors, including vegetation and the depth of desiccation (drying) cracks, but is usually less than 15 feet.

## 4.3 Structures Susceptible to Damage from Expansive Soils

Paradoxically, the structures most often damaged by expansive soil movements are lighter structures- e.g., residential and light (one - or two-story ) buildings, pavements/roadways, canal and reservoir linings, retaining walls, etc. Lightly loaded structures are especially vulnerable to damage because these structures are less able to suppress the differential heave of the swelling foundation soil than heavy structures (multistory buildings, tanks, etc).

Damages sustained by these structures include: distortion and cracking of pavements, and on-grade floor slabs; cracks in grade beams, walls, and drilled shafts; jammed or misaligned doors, and windows; buckling of basement and retaining walls, etc. The magnitude of these damages can be extensive,

impairing the usefulness of the structure, and detracting aesthetically. Repair requirements can be extensive, grossly exceeding the original cost of the foundation.

The cause of movements in expansive soil- either as heave (swelling with increased moisture) or settlement (shrinkage with loss of moisture)- is change in the soil moisture. The change may be caused by construction, release of water below or near the structure (for example by over-watering for landscaping or by releases from a ruptured pipe), or a variety of other factors. As discussed above, the soils on a tree covered site that has the trees suddenly removed for development may swell dramatically with the lessened demand for water. Similarly, a tree placed near a foundation as a part of a landscaping scheme, can draw water from the soil, leading to shrinkage and settlement of the structure.

## 4.4 Design to Limit the Potential for Damage to Foundations

### 4.4.1 Overview

Once expansive clays are identified as a material factor at a site, development of foundations involves evaluation of the cost, performance and risk associated with different design approaches. In general, these approaches consider the following:

1. Approach 1: *Bypass the clay*, by development of foundations founded below the clay prone to expansion (i.e., below the “active zone”), supporting a structure suspended above the clay.
2. Approach 2: *Found the structure within the clay*, designing the foundation and the structure to accommodate the effects of soil movement.
3. Approach 3: *Alter the clay*, either by removing it and replacing it with non-expansive soil or by treating the clay to remove its expansive characteristics.

Approach 1 and Approach 2 are structural solutions, discussed in Section 4.4.2. Approach 3 involves geotechnical solutions, discussed in Section 4.4.3.

### 4.4.2 Structural Solutions

As is noted above, expansive soils shrink and swell because the moisture content changes from dry to moist and vice versa. Thus, the guiding criteria in foundation design is that shrinking and swelling can be reduced if the moisture content is kept stable.

Design features can be taken to ensure that the soil under the foundation does not experience excessive moisture changes. Inexpensive and simple preventive measures to remove water away from the foundation may save thousands of dollars in costly repairs post-damage.

Damage from shrinking and swelling soils can also be reduced or prevented with proper foundation design. The initial additional cost of a properly designed foundation offsets the potential for extensive damage to the structure without reinforced foundations. The principal genres of foundation systems employed in expansive soil environments are as follows:

- *Drilled pier and beam*. Drilled pier and beam systems are designed to isolate the structure from expansive soil movements. The primary advantage is that it can be used for a variety of soils. The complexity of the design and construction is a major disadvantage. Additional cost is moderate to high. Risk assessment is low for soils of low to high expansion potential.

- *Stiffened slab-on-grade.* Designed to provide a rigid foundation to protect the structure from differential soil movement. Advantage is that no specialized equipment is required for construction. The approach is not applicable for basements and configuration of the structure must be simple. Additional cost is low to moderate. Risk assessment is low for soils of low to moderate expansion potential. Low to moderate risk is presumed for soils of high expansion potential.
- *Monolithic wall and slab.* Designed to provide a rigid foundation to resist differential soil movement. A primary advantage is that construction is simple. However, the procedure is ineffective in highly expansive soils. Additional cost is low. Risk assessment is low for soils of low to moderate expansion potential and high for soils with high expansion potential.

The preferred structural solution varies with locale and the severity of the problem. For example, pier and grade beam construction is common in the Rocky Mountain area, driven by the relatively greater severity of the expansive soil problem, as expansive soils are sourced from heavily over-consolidated and weathered shales and clays. In the Houston area, with less severe concerns for volume change (as a consequence of a generally more moist climate and less active clays), stiffened slab-on-grade construction is widely used. The active clay zones in soils in this area are deeper and wetter than those associated with western areas.

#### 4.4.3 Soil Solutions

Many treatment procedures are available for stabilizing expansive soils, as follows:

- Removal. Excavation and replacement with a non-expansive material is a common method of reducing shrink-swell risk. If the expansive soil or stratum is thin, then the entire layer can be removed. However, frequently the soil or stratum extends to a depth too great to remove economically and removal is limited to a few feet depth.
- Prewetting. Larger site areas- for example highways- are sometimes “prewettered” to force expansion. This approach is undertaken only if the increase to moisture content can be maintained. The approach is rarely used with buildings, as these low permeability, clayey soils may take years to prewet and can prewet unevenly.
- Lime Stabilization. This approach has been used extensively in highway and airfield projects. The addition of lime (CaO) and related building materials such as cement and flyash that contain lime creates reactions that both limit the swell potential of expansive soils and add strength. The lime stabilization of soils beneath the runway of the Dallas-Ft Worth airport in 1971 remains one of the largest such projects in history (the effort stabilized soils beneath 2.1 million sq yd of runway and taxiway areas).
- Compaction. Soils may be moisture conditioned and mechanically compacted.

## 4.5 Design to Limit the Potential for Damage to Pavements

Swelling and shrinkage of sub-grade soils are critical factors contributing to degradation of the serviceability of pavements. Like foundations, moisture control in design and maintenance is important to the long term performance of pavements. Design of paved surfaces, (including curbing, gutters and sidewalks) should include provisions to assure drainage of surface water. These recommendations are discussed in detail in Section 6.

## 5 RECOMMENDATIONS FOR FOUNDATIONS

### 5.1 Overview of Design for Light Foundations in Expansive Soils

The soils at this site will not be compressible under the light loads from the building. However, laboratory index testing indicates that the soils are moderately to highly “expansive”; that is, the soils will experience changes in volume- both shrinking and expanding- in response to changes in moisture content.

Two generic foundation systems are commonly used in expansive soil environments in the Westworth Village area, namely:

1. “Pier Supported.” This approach employs drilled piers which transfer building loads below the “active zone” (described in Section 4), thereafter employing a variety of slabs to support the superstructure.
2. “Ground Supported.” This approach founds the building on mats/slabs constructed atop the expansive soils. Foundations are stiffened to the degree necessary to limit the potential for building movement.

The table on the following page provides a matrix of the foundation alternatives that are employed in expansive soils. Decisions regarding a preferred foundation should be made considering the compatibility of the foundation system with the structural system and the desired architectural finishes (described below), cost, and the risk of building movement that NFCU wishes to tolerate.

Note also that no foundation system takes away all risks of building movement due to soil expansion.

### 5.2 Structural and Architectural Considerations

#### 5.2.1 Superstructure

A joist and wall framing system is planned for the new structure. This framing system will spread the building weight relatively uniformly on the foundation. The walls will be a combination of masonry and concrete.

The joist and wall system now planned is amenable to slab/mat-type foundations.

#### 5.2.2 Architectural Coverings

Different types of architectural finishes will respond differently to movement of the structure. Stiff, brittle surfaces (stucco, masonry, gypsum board (dry wall), glass, and tile, are less tolerable of movement than more flexible surfaces (e.g., stone coverings, carpet, wood, vinyl, etc).



### Overview of Foundation Alternatives

Foundation Type		Notes
Pier (Deep) Supported	Structural Slab with Piers	This type of foundation is considered to be low risk. A minimum crawl space of six-inches or larger is employed such that the floor slab is not in contact with the subgrade soils. The drilled footings must be placed below the potential “active zone” to minimize potential drilled footing upheaval.
	Slab-On-Fill Supported on Piers	This system has some risks with respect to foundation distress and movements. However, if positive drainage and vegetation control are provided, this type of foundation should perform satisfactorily.
	Floating (Stiffened) Slab Supported on Piers. (Conventionally-Reinforced or Post-Tensioned Slab)	Due to presence of piers, the slab cannot move down, but may move up, behaving like a floating slab. Steel from the drilled piers is not to be dowelled into the grade beams.
Grade (Shallow) Supported	Floating “Ribbed Mat” Structural Slab (Conventionally-Reinforced or Post-Tensioned)	No piers are used in this type of foundation. Many light to moderately loaded structures built on this type of foundation perform satisfactorily. The slab is significantly stiffened to minimize the potential for differential movement. The floor slab should be designed such that it can span between the grade beams.
	Floating Slab (Conventionally-Reinforced or Post-Tensioned)	No piers are used in this type of foundation. Many lightly-loaded structures in Texas are built on this type of foundation and are performing satisfactorily.

**Notes:**

1. Assumed in all of the above is a design focused toward minimizing the risk of foundation movement by design and maintenance of positive drainage and vegetation control.
2. Table is adapted from *Foundation Design Options for Residential and Other Low-Rise Buildings on Expansive Soils*, by the Foundation Performance Association - Structural Committee, Houston, Texas, Document # FPA-SC-01-0, 30 June 2004.

## 5.3 Recommended Foundation Alternatives

### 5.3.1 General

URS estimates the potential for soil rise in the vicinity of foundations to be on the order of one to three inches. In consideration of this potential, NFCU should consider foundations for the proposed banking facility from among the following two alternatives.

- Alternative 1, Structural Slab With Piers. If structural and architectural design will result in a settlement-sensitive structure, this type of foundation (which also includes a pier and beam foundation with a crawl space) will result in a low risk of any foundation movement if it is built and maintained in accordance with the recommendations for positive drainage and vegetation control described in this Section. A minimum void space of six-inches or larger is required beneath the floor slab, such that the structure will not be in contact with the subgrade soils. The drilled footings must be placed below the active zone to 20 feet below existing ground surface

(the active zone extends to about 10 feet depth). Designed as recommended in the following subsections, this foundation will likely experience negligible post-construction total or differential movement.

- Alternative 2, Stiffened Structural Slab (“Ribbed Mat”). If structural and architectural designs are adaptable, the building may be founded on a stiffened structural slab. Implemented with design and maintenance for moisture control, a stiffened slab will result in a low risk of damaging foundation movement. Foundation movement will be greater than with Alternative 1, but will not result in structural damage. The greatest potential movement is a limited “tilt” of the building, likely of limited perceptibility to users of the structure. This foundation will be less costly than Alternative 1. The foundation is employed very commonly in this area of Texas. Designed as recommended in the following subsections, this foundation may experience one to two inches of post construction vertical movement, with negligible differential movement.

In consideration of expected cost and performance, URS recommends use of the stiffened structural slab (Alternative 2, “Ribbed Mat”) as the foundation for the proposed single-story bank building, designing the mat in accordance with the criteria provided in Section 5.3.3.

Details regarding design for the above alternatives are provided in the following subsections.

### 5.3.2 *Alternative 1, Drilled Piers and Structural Slab*

#### 5.3.2.1 *General*

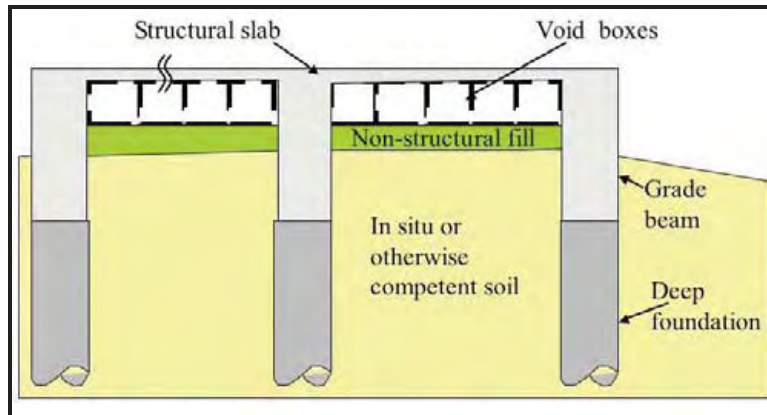
The graphic on the following page depicts this system. This system is intended to remove the structure from contact with the expansive soils, greatly limiting the potential for heave-related problems.

#### 5.3.2.2 *Pier Design for Axial Loads*

Drilled piers, either straight shafts or belled piers bearing at a minimum depth of 20 feet below existing ground surface may be used. Straight-sided or belled piers should be a minimum of 12” diameter. Should belled piers be selected, a maximum bell to shaft ratio of 2:1 is recommended. Piers may be designed for axial compression loads for a maximum end-bearing pressure of 2,500 pounds per square foot (psf), and skin friction of 400 psf for the portion of the pier below 10 feet depth. Skin friction should be considered for the straight shaft portion of the pier above the bell. Uplift forces on piers may be estimated as 400 psf for the depth interval 2 to 10 feet bgs. These forces will be resisted by a combination of dead-load and pier penetration below a depth of 8 feet.

#### 5.3.2.3 *Pier Installation*

Drilling to design depths should be possible with conventional single flight power augers. Shafts will probably remain open without stabilizing measures. However, pier concrete should be placed soon after completion of drilling and cleaning. Due to potential sloughing and raveling, foundation concrete quantities may exceed calculated geometric volumes. Pier concrete with a minimum slump of 6 inches is recommended.



**Generalized Application of Piers With Structural Slab**

Free-fall concrete placement in piers will only be acceptable if provisions are taken to avoid striking the concrete on the sides of the hole or reinforcing steel. The use of a bottom-dump hopper, or an elephant's trunk discharging near the bottom of the hole where concrete segregation will be minimized, is recommended. Any accumulated water greater than 2 inches should be pumped prior to placing concrete. In addition, concrete should be placed within 24 hours of completion of drilling.

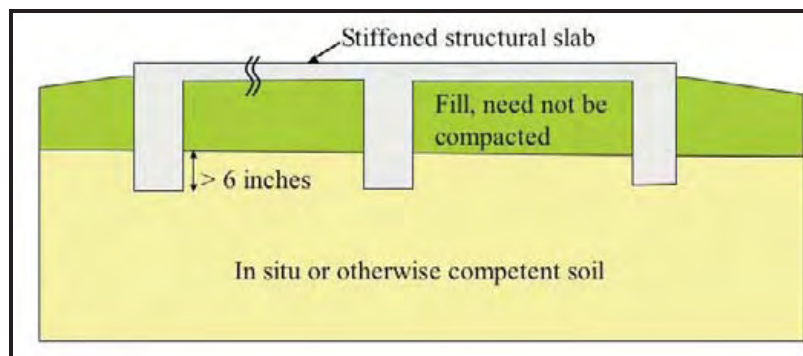
#### 5.3.2.4 Slab Design

The structural slab should be connected to grade beams that span between piers, designed to span between grade beams. The slab (not the grade beams) should be constructed about six (6) inches above the soil, using void carton forms to effect this separation. If a vapor retarder (e.g., polyethylene sheathing) is employed, the retarder should be placed above the carton forms. No removal of natural soils is necessary within the limits of the slab.

#### 5.3.3 Alternative 2, Stiffened Structural Slab

##### 5.3.3.1 General

The graphic below depicts this system. This system leaves the structure in contact with the expansive soils, providing structural stiffness to limit the potential for heave-related problems.



**Generalized Application of a Stiffened Structural Slab (“Ribbed Mat”)**

Also known as a “ribbed mat,” this is the foundation design commonly employed in the Fort Worth area for small, lighter structures of simple plan dimension, such as the planned banking facility. The rigidity of

the slab will minimize distortion of the superstructure from heaving soil, such that the greatest potential movement is a smallish 'tilt' that should be barely perceptible to users of the structure.

#### 5.3.3.2 *Design Criteria*

Prior to development, the upper three (3) feet of expansive soil within the building area should be removed and replaced with imported select fill. Select fill and its placement should conform to the requirements for such that are addressed in Section 5.5 (Site Design) and Section 5.6 (Site Preparation) of this report. Additional fill should be placed as necessary to raise the building area to the design grades.

Review of site design planning (Dwg C400 – Grading & Drainage Plan, 12/16/2011) indicates that engineered fill will be required over the majority of the site to raise it to the design elevations. Regardless of the need for fill, the upper three (3) feet of expansive soils should be removed from within the building limits prior to filling.

As depicted in the graphic on the preceding page, the structural slab should be designed with adequate stiffening beams, including a continuous peripheral beam to resist flexure or distortion from differential heave of the foundation soil. The grade beams may be founded in compacted select fill and designed for a net allowable contact stress (bearing pressure) of 2,000 psf, with a minimum width of 14", regardless of contact stress.

The structural slab may be conventionally reinforced or post-tensioned. The latter is more resistant to fracture than an equivalent section of a conventionally reinforced slab and uses less steel.

## 5.4 **Coordination of Design With Other Disciplines to Control Moisture**

Geotechnical, civil, structural, architectural and landscaping design for the facility must be undertaken with a view to the maintenance of an environment that encourages constant moisture conditions in the foundation soils and paved surfaces during and following construction.

Roof and surface drainage, landscaping, and utility connections must be designed to limit the potential for infiltration and/or releases of moisture beneath the structure. Similarly, the paved areas should include controls in design, construction and maintenance that limit the potential for infiltration of water beneath the paved surface.

## 5.5 **Site Design**

### 5.5.1 *General*

Moisture control is critical to any foundation design for this site. This section provides recommendations for site-related design appropriate to either Alternative 1 or Alternative 2.

### 5.5.2 *Improvements to Site Grades*

URS assumes that due to the extensive amount of tree clearing required in the proposed building area, removal of the roots may necessitate over four feet of select fill to be placed across the building and parking areas to bring the site to grade, and will be placed according to the specifications provided herein. If there are any significant deviations from the assumptions concerning fill placement when the final site plan is developed, the conclusions and recommendations of this report should be reviewed and

confirmed/modified as necessary to reflect the final planned site configuration. If fill is used, a relatively uniform thickness of fill (if required) should be placed beneath all portions of the building in order to minimize potential differential movement. Imported fill should be a granular material as described in Section 5.6 to reduce, or eliminate any potential long-term consolidation effects after placement and compaction, and to be compatible with on-site foundation soils.

### 5.5.3 *Drainage*

Planters and other surface features which could retain water in areas adjacent to the building or pavements should be sealed or eliminated.

In areas where sidewalks or paving do not immediately adjoin the structure, we recommend that protective slopes be provided with a minimum grade of approximately 2 percent for at least 10 feet from perimeter walls. Backfill against foundation elements, exterior walls, and in utility and sprinkler line trenches should be well compacted, non-expansive, low permeability and free of all construction debris to reduce the possibility of moisture infiltration. Downspouts, roof drains or scuppers should discharge into splash blocks to slabs or paving sloped away from the building.

### 5.5.4 *Landscaping*

Sprinkler systems should not be installed within 5 feet of foundations or floor slabs. Landscaping adjacent to the structure should be limited. No new trees should be planted. If used, trees should be planted the greater of (i) 15 feet away from foundation; or (ii) 1.5 times its mature height away from the foundation. Do not plant flowers or shrubs closer than five (5) feet from foundations.

### 5.5.5 *Utilities*

Underground piping within or near the structure should be designed with flexible couplings, so minor deviations in alignment do not result in breakage or distress. Utility knockouts in grade beams should be oversized to accommodate the potential for differential movements.

## 5.6 **Site Preparation**

### 5.6.1 *Weather*

Site development, to include pavements and foundations, should be undertaken during a period of expected drier weather.

### 5.6.2 *Clearing*

Prior to implementing construction, at the onset of any site grading, the entire building area and areas to receive pavements should be stripped of vegetation through the root zone.

### 5.6.3 *Select Fill*

Select fill should consist of material that meets the following:

- plasticity index between 4 and 15, with liquid limit less than 35, and
- less than 20 percent by weight passing the U.S. No. 200 sieve.

Fill placed to replace excavated expansive soils beneath the structure should be placed in lifts of 8 inches to 95% relative compaction after ASTM D 698 (the “standard Proctor”). Fill above that level may be placed to 92% relative compaction. USCS Classifications CL, CL-ML, GP, GC, GW and GM are allowable select fill.

## 6 RECOMMENDATIONS FOR PAVEMENTS

### 6.1 Site Preparation

#### 6.1.1 Removal of Unsuitable Material

Prior to the development of paved surfaces, site preparation should include the removal of the organics related to the root zone. This requirement will drive removal of one to three feet of soil in areas to receive pavements. The soils may then be brought up to grade with select fill material, as may be necessary.

#### 6.1.2 Lime Stabilization

The upper 24 inches of the expansive soils in areas to receive pavements should be stabilized by the mixing of lime with the soil, adding lime at a rate of 7% by weight lime by either the 'lime' or "lime slurry" methods as described in Texas DOT Standard Specifications, Item 260. Thereafter, the stabilized soil should be densified to 95% relative compaction after ASTM D 698 (the "Standard Proctor"). This stabilization and densification will increase the modulus of subgrade reaction and the life expectancy of the pavement.

#### 6.1.3 Select Fill

Any fill above the lime-stabilized surface should be a select fill consisting of low plasticity sandy clay to clayey sands with a plasticity index between 4 and 15, liquid limit less than 35 and not more than 20 percent by weight passing the U.S. No. 200 sieve. The select fill should be compacted in lifts of 8 inches to 95% Standard Proctor Maximum Dry Density (ASTM D 698). USCS Classifications CL, CL-ML, GP, GC, GW and GM are allowable replacement materials.

### 6.2 Design for Control of Moisture

#### 6.2.1 Design Features

Maintenance of stable moisture content of the subgrade soils is important. The long term performance of pavements constructed on the expansive soil at this site may be improved by attention to design features that limit the potential for moisture to enter the subsurface.

Since the soils have shrink/swell characteristics, pavements could crack in the future primarily because of expansion of the soils when subjected to an increase in moisture content to the subgrade. The cracking, while not desirable, cracking does not necessarily constitute structural failure of the pavement. The following recommendations should be considered at minimum:

- grade the site (seeking a minimum 2% ) to keep water off of pavements;
- compaction in any utility trenches for landscaped areas should meet the same criteria as the pavement subgrade;
- seal any/all landscaped areas in, or adjacent to pavements;
- place compacted backfill against the exterior side of curb and gutter; and,
- place curb, gutter and/or sidewalk directly on subgrade soils without the use of base course materials.

### 6.2.2 Maintenance

Design of pavements should include a planned program of preventative maintenance. Preventative maintenance consists of both localized maintenance (e.g. crack sealing and patching) and global maintenance (e.g. surface sealing). Preventative maintenance is usually the first priority when implementing a planned pavement maintenance program and provides the highest return on investment for pavements.

## 6.3 Rigid Pavement Design

### 6.3.1 Design Basis

Two pavement designs are recommended. One design is for the entrance and areas where truck traffic is expected. The second is for the parking area where light traffic is anticipated.

### 6.3.2 Recommended Pavement Sections

The table below provides pavement sections above the stabilized subgrade for rigid pavements.

Area	Thickness of Graded Aggregate Base (inches)	Thickness of Concrete Surfacing (inches)
Entrance/Light Truck Traffic	6	6
Dumpster Pad	6	10
Parking/Automobile Traffic	4	5

**Note:** Graded Aggregate base should conform to TxDOT, compacted to at least 100% of the maximum density determined by ASTM D698.

### 6.3.3 Concrete Specifications

The concrete should have a minimum flexural strength of 4,000 psi at 28 days and should have proper joint spacing to prevent excessive slab curling and shrinkage cracking. Expansion joints should be provided whenever the pavement abuts other structures or poles. If these areas are accessible to wheel loads, slab thickness should be increased by 25% and tapered to the design thickness in 5 feet. Curbs or down-turned sections should be used where pavements abut landscaping areas, drainage swales, or any water retention basins.

Temperature steel in concrete pavement consisting of wire mesh or ribbed reinforcing bar running in both directions is recommended. The use of rolled wire mesh is not recommended because it is too difficult to keep the rolled mesh at the proper depth in the concrete slab.

## 6.4 Flexible Pavement Design

### 6.4.1 Design Basis

Two pavement designs are recommended. One design is for the entrance and areas where truck traffic is expected. The second is for the parking area where light traffic is anticipated.

#### 6.4.2 Recommended Flexible Pavement Sections

The table below provides pavement sections above the lime-stabilized subgrade for flexible (asphalt) pavements.

Area	Thickness of Graded Aggregate Base (inches)	Thickness of Asphalt Surfacing (inches)
Entrance/Light Truck Traffic	8	3.5
Parking/Automobile Traffic	6	2

**Note:** Graded Aggregate base should conform to TxDOT, compacted to at least 100% of the maximum density determined by ASTM D698.

#### 6.5 Control of Moisture in Construction

Pavement materials should not be placed when the subgrade is wet. Good surface drainage should be provided away from the edges of the paved areas to minimize lateral moisture transmission into the subgrade. If the subgrade soils experience a significant increase in moisture content, accelerated pavement deterioration and increased maintenance should be anticipated.



## 7 RECOMMENDATIONS FOR MAINTENANCE

### 7.1 Foundations

NFCU should provide regular maintenance and maintenance-related inspections of foundations during the entire period of its ownership. Inspections should be undertaken at regular intervals (perhaps twice per year) and document the interior and exterior condition of the building, especially the occurrence of maintenance concerns that could reflect emerging problems with soil movement. The best time for such inspections is following the dry and wet seasons. The table below provides guidance regarding the scope of an exterior and interior building inspection.

**Foundation Inspection Checklist**

Category	Items to Check (at six-month intervals)	✓
Cracks & Separations	Check for new or changed cracks or separations in the walls. If evident, do not repair them without first having a forensic engineer assess the cause.	
	Check that masonry expansion joints are of uniform width top to bottom and the mortar joints are aligned.	
Drainage	Check that water does not pool near the foundation after a heavy rain. If found, correct the grade slope or add underground drainage.	
	Check the automatic sprinkler system (if applicable) for proper settings to give the site vegetation sufficient moisture, but without over-watering.	
	Check that flatwork around the structure are providing drainage from the foundation.	
	Check that cracks/openings in pavements are repaired.	
	Check that downspouts and gutters are clean, and water from downspouts is directed away from the foundation.	
	Check for clogs or leaks in any existing downspout extensions, area drains, or underground drainage pipes, and clean and repair as required.	
	Check that there is no new tree or bush of any kind near the foundation. If found, remove.	
Vegetation	Check that there are no shrubs next to the foundation that have grown to the point where they approach a one story roof in height. If found, cut them back to window height or replace them with a smaller variety.	
	Check that no leaks have developed near the foundation, such as a faucet drip, a condensate drip from an air conditioning unit, etc. If found, repair as needed.	
Water Leaks	Check that the underground drainage system (if applicable) is properly functioning. If it does not drain freely, investigate and clean as needed to achieve normal flow.	
	Check that all plumbing works properly, and that there is no stoppage or leaks. If found, repair as needed.	
	Check that there are no uncomfortable floor slopes by walking each room.	
Miscellaneous	Check that joists/rafters (as applicable) are not pulled away from ridge members.	
	Check that each door hangs and operates properly.	
	Check interior countertops, cabinets etc. for levelness and proper operation.	

## 7.2 Pavements

Concurrent with foundation inspections, NFCU should provide regular maintenance and maintenance-related inspections of pavements. These inspections should document both (i) the condition of the pavements and (ii) implementation of maintenance to address emerging problems with soil movement. The table below provides guidance regarding the scope of a pavement inspection.

**Pavements Inspection Checklist**

Category	Items to Check (at six-month intervals)	✓
Cracks & Separations	Check for new or changed cracks or separations in the pavements, or pavement/curbing interface, especially vertical offsets sufficient to cause tripping. Repair/seal as necessary.	
	Check that previously repaired/sealed cracks remain sealed.	
Drainage	Check that water does not pool in paved areas after a heavy rain. If found, correct the grade/slope/drainage creating the problem.	
	Check that drop inlets are providing drainage of surface water.	
	Check that cracks/openings in pavements are repaired.	
	Check that pavements have maintained grades, allowing no standing/pooled water.	
	Check there is no new tree or bush of any kind near the pavement. If found, remove.	
	Check that there are no shrubs next to pavements greater than 8 feet height. If found, cut back or replace with a smaller variety.	
	Check that no surface drainage from offsite sources onto on site pavements.	
Miscellaneous	Surface sealing of paved areas in good condition	
	Drainage keeps moisture from the edges of pavements	
	Striping, signage and lighting in good repair	
	No vertical offsets at the entrance from the street to the paved area	

## **8 QUALIFICATIONS TO THIS REPORT**

### **8.1 Intended Users**

This report is intended for use by NFCU for specific application to development of the proposed NFCU banking facility in Westworth Village, Tarrant County, Texas, as described herein.

### **8.2 Standard of Care**

The report has been prepared in accordance with generally accepted engineering practices in soils of this nature in this area. No other warranty, expressed or implied, is made.

The recommendations discussed herein are based on URS' interpretation of the site conditions of this project as indicated primarily by the soil borings, and on the results of subsequent engineering analyses and completion of the boring work. In particular, URS' interpretation of subsurface conditions relies on isolated borings and assumptions regarding conditions between the actual points sampled, thus involving the inherent risk that some subsurface conditions will not be detected. Actual conditions may vary significantly between the points investigated. All persons making use of this report with our express written consent should be aware of this risk.

### **8.3 Design Review**

Prior to finalizing design, it is recommended that URS be retained to review the design documents for conformance to the recommendations set forth in this report.

The conditions of the expansive soils described herein are subject to change over time. Those making use of the report should be aware of this possibility and understand that the report only presents the conditions at the sampled points at the time of sampling.

### **8.4 Surveillance During Construction**

The contents of this report have been tailored to the requirements of the proposed development, with particular concern for the potential effects of expansive soils on the long term performance of foundations and pavements.

Construction of the foundations and pavements recommended herein will require proper professional surveillance in construction. If conditions different from those encountered in the geotechnical study are observed during construction, it is recommended that URS be contacted immediately to evaluate the situation and, if appropriate, provide supplemental recommendations.

The users of this report are reminded that the long term performance of the foundations and pavements recommended herein will require attention to the moisture control considerations described in the report both during and after construction.

## 9 REFERENCES

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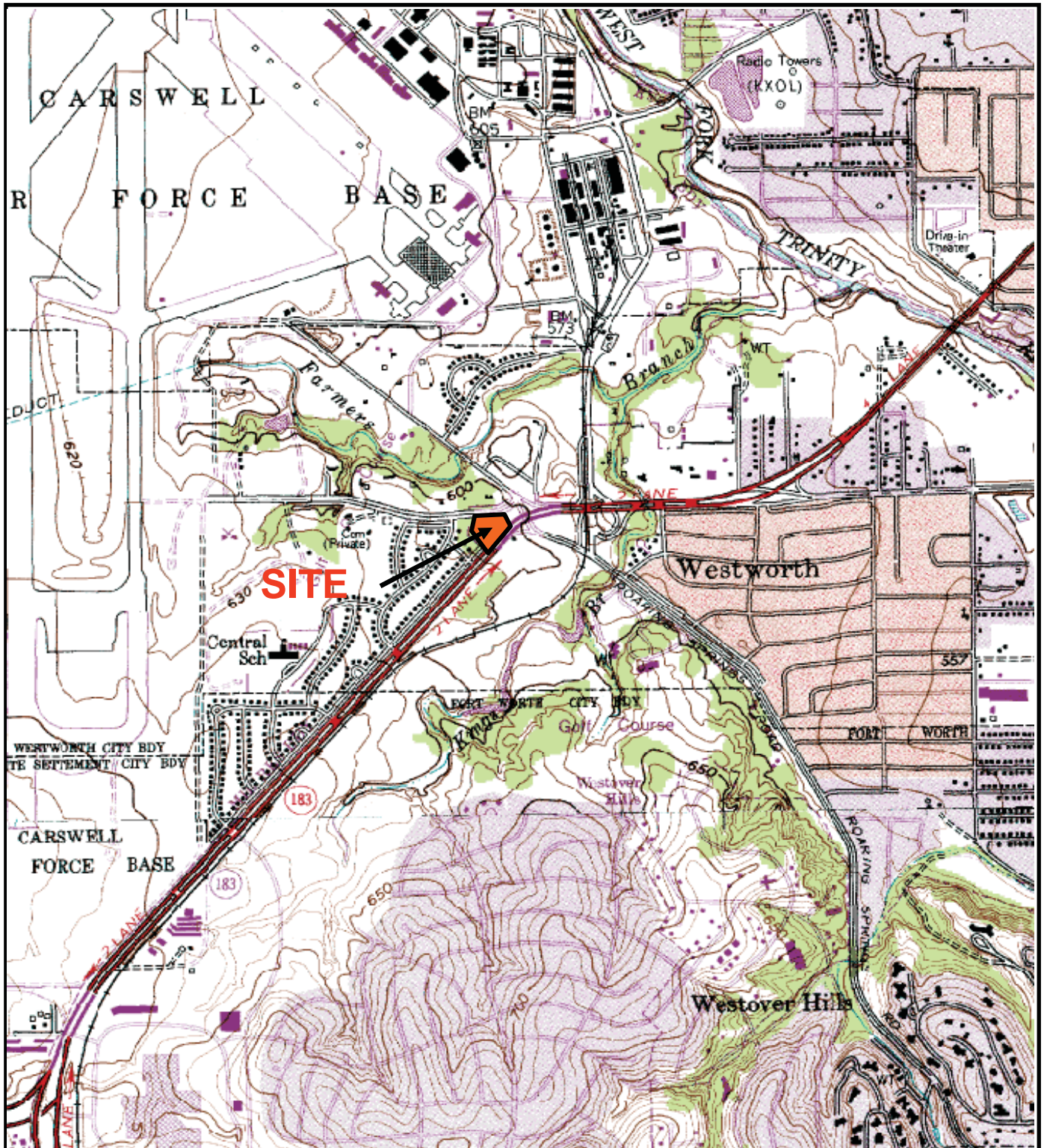
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**APPENDIX A**

**FIGURES**



Source:  
 TopoZone, 2003  
 Lake Worth, Texas 7.5-Minute Quadrangle Map



SITE LOCATION MAP	
WESTWORTH VILLAGE Tarrant County, Texas	
Prepared For: <b>NFCU</b>	 SCALE IN MILES (APPROX.)
PROJECT MGR.: RT	
DRAWN BY: SRC	
DATE: 06/11/08	
PROJECT NO.: 11656886	Fig. 1



**LEGEND**

- Property Boundary
- Soil Boring (January 2007)
- Soil Boring (June 2008)

Source:  
Google Earth, 2006



BORING LOCATION MAP		
Westworth Village Tarrant County, Texas		
Prepared For: <b>NFCU</b>	<p>SCALE IN MILES (APPROX.)</p>	
PROJECT MGR.: RT		
DRAWN BY: SRC		
DATE: 06/11/08		
PROJECT NO.: 11656886		
		Fig. 2

**APPENDIX B**  
**SOIL BORING LOGS**



**BORING LOGS  
JANUARY 2007**

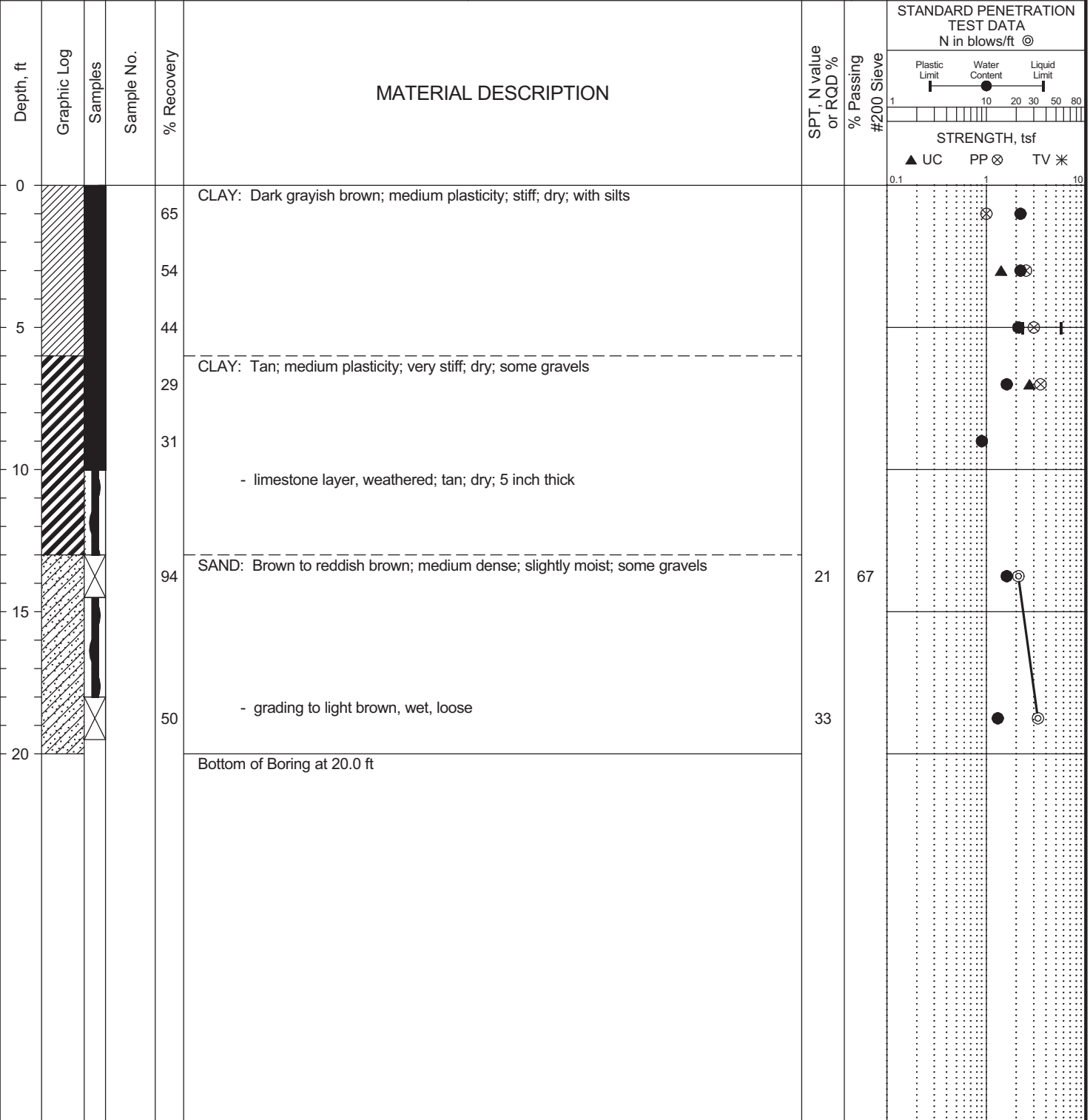


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# LOG OF BORING SB-1

Sheet 1 of 1

Project: NFCU Banking Facility	Drilling Method: Hollow Stem Auger Sampling Method: Shelby Tube; Split Spoon	WATER LEVELS	
Job No.: 11656886		While Drilling:	End of Drilling:
Location: Westworth Village, Texas		hrs After Drilling:	
Coordinates:			



Completion Depth: 20.0	Sample Types:	Remarks:
Date Boring Started: 1/26/07	Shelby Tube	4.0% Strain and 101.9 PCF Dry Density at 2-4 ft
Date Boring Completed: 1/26/07	Auger Cuttings	8.1% Strain and 111.0 PCF Dry Density at 6-8 ft
Logged By: SRC	Split Spoon	Plasticity Index at 4-6 ft
Drilling Contractor: Total Support Services		

The stratification lines represent approximate boundaries. The transition may be gradual.

LOG OF BORING: GEOTECHNICAL LOGS.GPJ URS DALLAS.GDT 6/13/08



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# LOG OF BORING SB-2

Sheet 1 of 1

Project: NFCU Banking Facility	Drilling Method: Hollow Stem Auger	WATER LEVELS While Drilling: End of Drilling: hrs After Drilling:
Job No.: 11656886	Sampling Method: Shelby Tube; Split Spoon	
Location: Westworth Village, Texas		
Coordinates:		

Depth, ft	Graphic Log	Samples	% Recovery	MATERIAL DESCRIPTION	SPT, N value or RQD %	% Passing #200 Sieve	STANDARD PENETRATION TEST DATA N in blows/ft @	
							Plastic Limit	Liquid Limit
0			25	CLAY: Dark grayish brown; medium plasticity; stiff; dry; some sands			10	20
5			33	- limestone; weathered; tan; slightly moist			54	10
10			50	CLAY: Tan; medium plasticity; hard; dry; some sands			45	30
15			22	SAND: Brownish tan; fine-grained; loose to medium dense; moist; some gravels			41	30
20			22	- grading to light brown; loose; wet			38	15
20.0				Bottom of Boring at 20.0 ft				

Completion Depth: 20.0	Sample Types: Shelby Tube, Split Spoon, Auger Cuttings	Remarks: 11.2% Strain and 112.6 PCF Dry Density at 2-4 ft 24 Plasticity Index at 2-4 ft
Date Boring Started: 1/26/07		
Date Boring Completed: 1/26/07		
Logged By: SRC		
Drilling Contractor: Total Support Services		

The stratification lines represent approximate boundaries. The transition may be gradual.

LOG OF BORING: GEOTECHNICAL LOGS.GPJ URS DALLAS.GDT 6/13/08

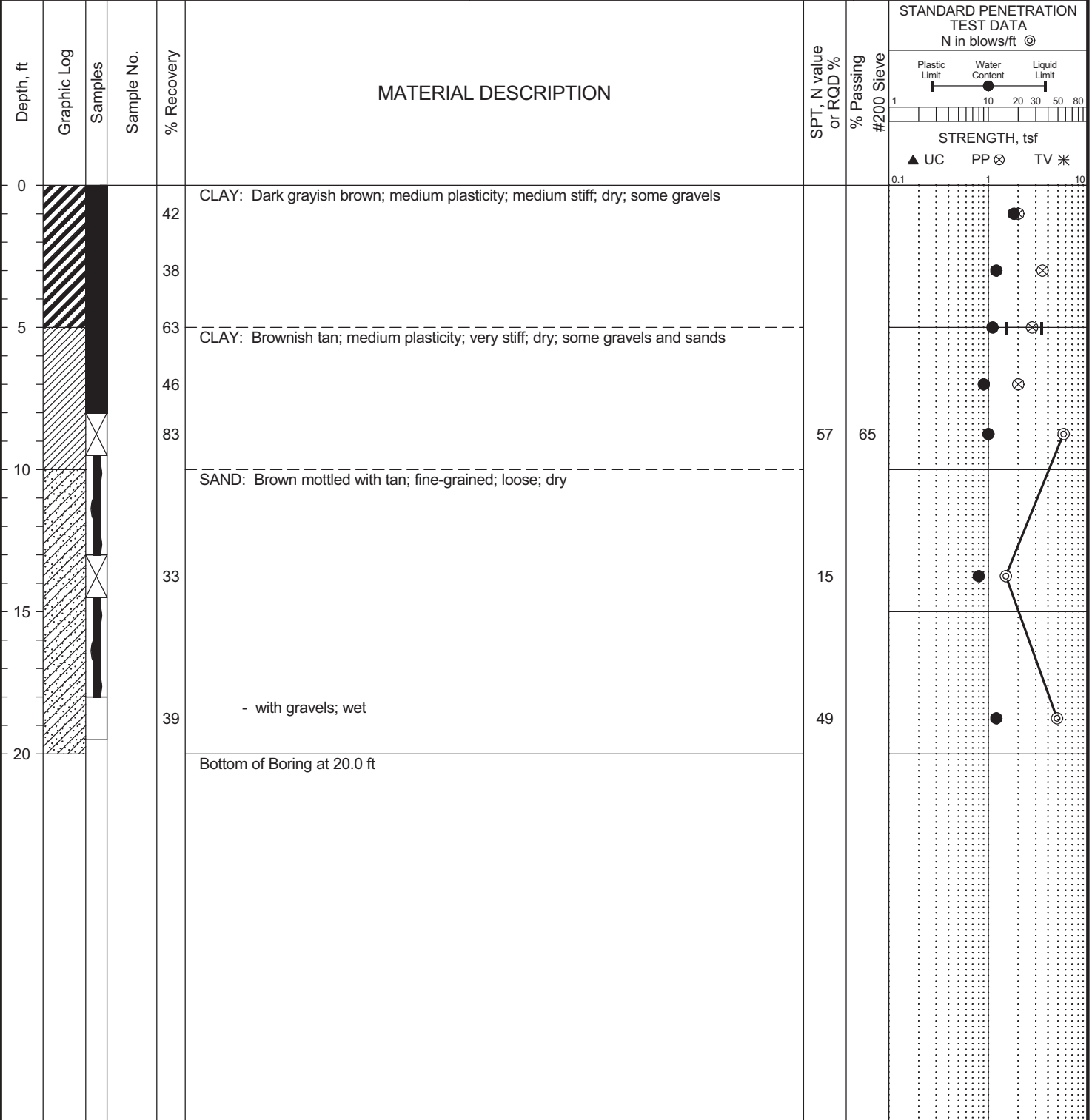


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# LOG OF BORING SB-3

Sheet 1 of 1

Project: NFCU Banking Facility	Drilling Method: Hollow Stem Auger	WATER LEVELS While Drilling: End of Drilling: hrs After Drilling:
Job No.: 11656886	Sampling Method: Shelby Tube; Split Spoon	
Location: Westworth Village, Texas		
Coordinates:		



Completion Depth: 20.0	Sample Types: Shelby Tube, Split Spoon, Auger Cuttings	Remarks: 19 Plasticity Index at 4-6 ft
Date Boring Started: 1/26/07		
Date Boring Completed: 1/26/07		
Logged By: SRC		
Drilling Contractor: Total Support Services		

The stratification lines represent approximate boundaries. The transition may be gradual.

LOG OF BORING GEOTECHNICAL LOGS.GPJ URS DALLAS.GDT 6/13/08

**BORING LOGS  
JUNE 2008**



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# LOG OF BORING SB-1A

Sheet 1 of 1

Project: NFCU Banking Facility	Drilling Method: Solid Stem Auger Sampling Method: Shelby Tube; Split Spoon	WATER LEVELS	
Job No.: 11656886		While Drilling:	
Location: Westworth Village, Texas		End of Drilling:	
Coordinates:		hrs After Drilling:	

Depth, ft	Graphic Log	Samples	Sample No.	% Recovery	MATERIAL DESCRIPTION	SPT, N value or RQD %	% Passing #200 Sieve	STANDARD PENETRATION TEST DATA N in blows/ft @		
								Plastic Limit	Water Content	Liquid Limit
0				100	CLAY: Silty; vey stiff; medium plasticity; dark brown; dry; some sands					
5				85	CLAY: Silty; very stiff; medium plasticity; mottled brown/tan; dry - limestone fragments; weathered; hard; tan; dry - limestone layer (~ 10 inches); weathered; hard; tan; dry - limestone fragments; weathered; hard; tan; dry					
15				0	SAND: Loose; fine-grained; mottled brown/tan; wet; frequent gravels					
					Bottom of Boring at 18.0 ft					

Completion Depth: 18.0	Sample Types:  Shelby Tube  Auger Cuttings	Remarks: 7.6% Strain and 112.1 PCF Dry Density at 4-6 ft
Date Boring Started: 6/4/08		
Date Boring Completed: 6/4/08		
Logged By: SRC		
Drilling Contractor: Stratacore, Inc		

The stratification lines represent approximate boundaries. The transition may be gradual.

LOG OF BORING: GEOTECHNICAL LOGS.GPJ URS DALLAS.GDT 6/13/08



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# LOG OF BORING SB-2A

Sheet 1 of 1

Project: NFCU Banking Facility  
 Job No.: 11656886  
 Location: Westworth Village, Texas  
 Coordinates:

Drilling Method: Solid Stem Auger  
 Sampling Method: Shelby Tube;  
 Split Spoon

**WATER LEVELS**  
 While Drilling:  
 End of Drilling:  
 hrs After Drilling:

Depth, ft	Graphic Log	Samples	Sample No.	% Recovery	MATERIAL DESCRIPTION	SPT, N value or RQD %	% Passing #200 Sieve	STANDARD PENETRATION TEST DATA	
								N in blows/ft	Strength, tsf
0				90	CLAY: Silty; very stiff; medium plasticity; dark brown; dry				
5					- grading to brown silty clay - limestone fragments				
10				79	CLAY: Very stiff; tan; dry; frequent gravels				
15				85	- limestone layer (~6 inches); weathered; hard; tan				
20					- grading to reddish brown clay; limestone fragments				
					SAND: Clayey; loose; fine-grained; tan; moist				
					- grading to coarse-grained sand; wet	13			
					Bottom of Boring at 20.0 ft				

Completion Depth: 20.0  
 Date Boring Started: 6/4/08  
 Date Boring Completed: 6/4/08  
 Logged By: SRC  
 Drilling Contractor: Stratacore, Inc

Sample Types:  
 Shelby Tube  
 Auger Cuttings  
 Split Spoon

Remarks:  
 11.7% Strain and 102.4 PCF Dry Density at 13-15 ft  
 31 Plasticity Index at 13-15 ft

LOG OF BORING GEOTECHNICAL LOGS.GPJ URS DALLAS.GDT 6/13/08

The stratification lines represent approximate boundaries. The transition may be gradual.



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# LOG OF BORING SB-3A

Sheet 1 of 1

Project: NFCU Banking Facility  
 Job No.: 11656886  
 Location: Westworth Village, Texas  
 Coordinates:

Drilling Method: Solid Stem Auger  
 Sampling Method: Shelby Tube;  
 Split Spoon

**WATER LEVELS**  
 While Drilling:  
 End of Drilling:  
 hrs After Drilling:

Depth, ft	Graphic Log	Samples	Sample No.	% Recovery	MATERIAL DESCRIPTION	SPT, N value or RQD %	% Passing #200 Sieve	STANDARD PENETRATION TEST DATA	
								N in blows/ft	Water Content
0				63	CLAY: Silty; very stiff; medium plasticity; dark brown; dry; frequent calcareous nodules				
5				50	- grading to brown silty clay - limestone fragments				
10				100	CLAY: Sandy; hard; medium plasticity; tan; dry; some gravels				
15				90	- grading to mottled tan/reddish brown - limestone layer (~10 inches); weathered; hard; tan				
					SAND: Medium dense; coarse-grained; brownish tan; moist				
					- wet				
					Bottom of Boring at 18.0 ft				

Completion Depth: 18.0  
 Date Boring Started: 6/4/08  
 Date Boring Completed: 6/4/08  
 Logged By: SRC  
 Drilling Contractor: Stratacore, Inc

Sample Types:  
 Shelby Tube

Remarks:  
 5.0% Strain and 115.6 PCF Dry Density at 6-8 ft  
 6.7% Strain and 117.0 PCF Dry Density at 8-10 ft 32  
 Plasticity Index at 8-10 ft

LOG OF BORING: GEOTECHNICAL LOGS.GPJ URS DALLAS.GDT 6/13/08

The stratification lines represent approximate boundaries. The transition may be gradual.



**APPENDIX C**  
**LABORATORY TESTING RESULTS**

**ANALYTICAL RESULTS**  
**JANUARY 2007**

BORING	DEPTH (Feet)	MOISTURE (%)	UNIT DRY WT (PCF)	PASSING #200 (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (PI)	COMP. STR (TSF)	STRAIN, %
SB - 1	0 - 2	21.8							
	2 - 4	22.1	101.9					1.40	4.0
	4 - 6	20.6			56	23	33		
	6 - 8	16.4	111.0					2.70	8.1
	8 - 10	9.3							
	13 - 15	15.5		66.6					
	18 - 20	13.0							
SB - 2	0 - 2	13.5							
	2 - 4	14.2	112.6		43	19	24	2.38	11.2
	4 - 6	7.4							
	6 - 8	10.5							
	8 - 10	8.9							
	13 - 15	17.9							
	18 - 20	10.4		15.3					
SB - 3	0 - 2	17.7							
	2 - 4	12.1							
	4 - 6	10.5			34	15	19		
	6 - 8	8.9							
	8 - 10	9.9		64.9					
	13 - 15	8.2							
	18 - 20	12.1							

**MOISTURE CONTENT - %PASSING#200 - PLASTICITY INDEX**

JOB NUMBER: DA07720 - 30

PROJECT NAME: NFOV (VNS)

MOISTURE CONTENT

MOISTURE CONTENT

LIQUID LIMITS

PLASTIC LIMITS

PLASTIC INDEX

SET UP BY: DM/KC  
TESTED BY: GK

SET UP DATE: 02-09-07  
DATE TESTED: 02/12/07

BORING NUMBER	DEPTH, FEET	TARE CAN NO.	TARE WEIGHT, gms.	WET + TARE, gms.	DRY + TARE, gms.	MOISTURE		TARE CAN NUMBER	TARE, gms.	AFTER WASH DRY TARE, gms.	PASSING #200		TARE CAN NUMBER	TARE, gms.	WET + TARE, gms.	DRY + TARE, gms.	BLOWS	LIQUID LIMITS		PLASTIC LIMITS			
						MOISTURE	%				MOISTURE	%						PLASTIC LIMITS	PLASTIC INDEX				
SB-1	0-2	1	38.74	973.18	313.35	21.8																	
			SAMPLE DESCRIPTION: Sand, clay w/ fine sand, reddish brown																				
			37.09	315.33	265.02	20.1																	
V0	2-4	2	SAMPLE DESCRIPTION: Sandy clay																				
			SAMPLE DESCRIPTION: Clay w/ gravel, yellowish brown																				
			34.59	504.78	276.78	20.6			A1	13.72	86.93	60.20	20	56	A2	13.47	21.32	22.32	23	23			
V1	2-6	3	SAMPLE DESCRIPTION: Clay w/ gravel, yellowish brown																				
			SAMPLE DESCRIPTION: Clay w/ gravel, yellowish brown																				
			37.93	385.30	334.46	16.4																	
V2	6-8	4	SAMPLE DESCRIPTION: Clay w/ gravel, yellowish brown																				
			SAMPLE DESCRIPTION: Clay w/ gravel, yellowish brown																				
			38.20	316.43	222.68	9.3																	
Hydr	13-15	5	SAMPLE DESCRIPTION: Clay w/ gravel, yellowish brown																				
			SAMPLE DESCRIPTION: Clay w/ gravel, yellowish brown																				
			38.54	276.60	249.19	13.0																	
Hydr	18-20	7	SAMPLE DESCRIPTION: Clay w/ gravel, yellowish brown																				
			SAMPLE DESCRIPTION: Clay w/ gravel, yellowish brown																				
			SAMPLE DESCRIPTION: Clay w/ gravel, yellowish brown																				





# UNCONFINED COMPRESSION TEST

Job No.: DA07720 HOLE: SB-1 DEPTH: 2-to-4

Job Name: NFCV (URS) DATE: \_\_\_\_\_

Description: \_\_\_\_\_

BLOW COUNT: \_\_\_\_\_

DATE: 02-13-07

LOAD CELL NO.: \_\_\_\_\_

STRAIN in/min. \_\_\_\_\_

DIAMETER, in.: 2.715

Load (lbs)	Load On Specimen (pcf)	Strain Reading	Unit Strain	Corrected Area	Total Strain (%)	Corrected Stress (pcf)
0		0				
53		25				
72		50				
87		75				
98		100				
105		125				
113		150				
116		175				
117		200			4.0	2795
114		205				

### Density

Length, in.: 5.057

Volume, cu. ft.: \_\_\_\_\_

Wet wt., g: 955.58

Dry wt., g: \_\_\_\_\_

Dry density, pcf.: \_\_\_\_\_

Wet unit wt.: 124.3

Dry density, pcf.: 101.9

### Moisture

Dish No. 2

Dish /soil wt., g: 315.33

Dish/dry soil, g: 265.02

Dish wt. g: 37.09

Water wt. g: \_\_\_\_\_

Dry soil wt., g: \_\_\_\_\_

Moisture %: 22.1

Saved for: \_\_\_\_\_

1.40 T S F

### Sketch



Unit strain = L/L

Corrected area = A/A - Unit Strain

Tested by: DM

Calculated by: DM

Reviewed by: \_\_\_\_\_

# UNCONFINED COMPRESSIVE STRENGTH TEST

DA07720 - 300, SB - 1 @ 2' - 4' ( URS Corporation )

**NATURAL DRY DENSITY**

Diameter (in.)= 2.715 in.  
 Length (in.) = 5.057 in.  
 Wet Weight (g) = 955.58 g

Soil Wt. = 2.10666 lb  
 Area = 0.0402 ft<sup>2</sup>  
 Volume = 0.01694 ft<sup>3</sup>  
 Wet Density = 124.3 pcf

Dry Density = **101.9 pcf**

**MOISTURE CONTENT**

Wet Soil & Dish Wt. = 315.33 g  
 Dry Soil & Dish Wt. = 265.02 g  
 Dish Wt. = 37.09 g

Moisture Content = **22.1 %**

Load (lbs)	Strain Reading	Total Strain (%)	Corrected Stress (psf)
0	0	0	0
53	25	0.5	1312
72	50	1.0	1773
87	75	1.5	2132
98	100	2.0	2389
105	125	2.5	2547
113	150	3.0	2727
116	175	3.5	2785
117	200	4.0	2795
116	205	4.1	2768

1.40 TSF



# UNCONFINED COMPRESSION TEST

Job No.: DA07720 HOLE: S8-1 DEPTH: 6 to 8

Job Name: NFCV DATE: \_\_\_\_\_

Description: clay w/ cat nodes, lt yellowish brown

BLOW COUNT: \_\_\_\_\_  
 DATE: 02-09-07  
 LOAD CELL NO.: \_\_\_\_\_  
 STRAIN in/in. \_\_\_\_\_  
 DIAMETER, in.: 2.752

Load (lbs)	Load On Specimen (pcf)	Strain Reading	Unit Strain	Corrected Area	Total Strain (%)	Corrected Stress (pcf)
0		0				
37		25				
68		50				
91		75				
105		100				
117		125				
131		150				
148		175				
163		200				
190		250				
210		300				
228		350				
238		400				
243		450			8.1	5409
242		477				

### Density

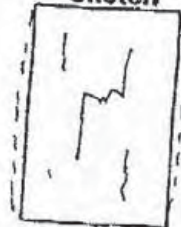
Length, in.: 5.590  
 Volume, cu. ft.: \_\_\_\_\_  
 Wet wt., g: 1127.7  
 Dry wt., g: \_\_\_\_\_  
 Dry density, pcf.: \_\_\_\_\_  
 Wet unit wt.: 129.2  
 Dry density, pcf.: 111.0

### Moisture

Dish No. 4  
 Dish / soil wt., g: 385.38  
 Dish / dry soil, g: 336.45  
 Dish wt. g: 37.93  
 Water wt. g: \_\_\_\_\_  
 Dry soil wt., g: \_\_\_\_\_  
 Moisture %: 16.4  
 Saved for: \_\_\_\_\_

2.70 T S F

### Sketch



Unit strain = LL

Corrected area = A/4 - Unit Strain

Tested by: DM Calculated by: AM Reviewed by: \_\_\_\_\_

# UNCONFINED COMPRESSIVE STRENGTH TEST

DA07720 - 300, SB - 1 @ 6' - 8' ( URS Corporation )

## NATURAL DRY DENSITY

Diameter (in.) = 2.752 in.  
 Length (in.) = 5.59 in.  
 Wet Weight (g) = 1127.7 g

Soil Wt. = 2.48611 lb  
 Area = 0.04131 ft<sup>2</sup>  
 Volume = 0.01924 ft<sup>3</sup>  
 Wet Density = 129.2 pcf

Dry Density = **111.0 pcf**

## MOISTURE CONTENT

Wet Soil & Dish Wt. = 385.38 g  
 Dry Soil & Dish Wt. = 336.45 g  
 Dish Wt. = 37.93 g

Moisture Content = **16.4 %**

Load (lbs)	Strain Reading	Total Strain (%)	Corrected Stress (psf)
0	0	0	0
37	25	0.4	892
68	50	0.9	1631
91	75	1.3	2173
105	100	1.8	2496
117	125	2.2	2769
131	150	2.7	3086
148	175	3.1	3471
163	200	3.6	3805
190	250	4.5	4394
210	300	5.4	4811
228	350	6.3	5174
238	400	7.2	5349
243	450	8.1	5409
242	477	8.5	5369

2.70 TSF.

# UNCONFINED COMPRESSION TEST

Job No.: DA 07720 HOLE: S13-2 DEPTH: 2-to-4

Job Name: \_\_\_\_\_ DATE: \_\_\_\_\_

Description: \_\_\_\_\_

BLOW COUNT: \_\_\_\_\_

DATE: 02-09-07

LOAD CELL NO.: \_\_\_\_\_

STRAIN in/min. \_\_\_\_\_

DIAMETER, in.: 2.680

Load (lb)	Load On Specimen (psf)	Strain Reading	Unit Strain	Corrected Area	Total Strain (%)	Corrected Stress (psf)
0		0				
21		25				
42		50				
64		75				
87		100				
108		125				
123		150				
135		175				
149		200				
172		250				
190		300				
203		350				
210		400				
212		450			11.2	4762
211		459				

### Density

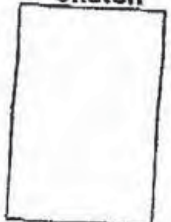
Length, in.: 3.58  
Volume, cu. ft.: \_\_\_\_\_  
Wet wt., g: (21) .80  
Dry wt., g: \_\_\_\_\_  
Dry density, pcf.: \_\_\_\_\_  
Wet unit wt.: 128.6  
Dry density, pcf.: 112.6

### Moisture

Dish No. 9  
Dish / soil wt., g: 346.31  
Dish / dry soil, g: 308.11  
Dish wt. g: 38.60  
Water wt. g: \_\_\_\_\_  
Dry soil wt., g: \_\_\_\_\_  
Moisture %: 14.2  
Saved for: \_\_\_\_\_

2.38 T S F

Sketch



Unit strain = L/L

Corrected area = A/A - Unit Strain

Tested by: DM

Calculated by: km

Reviewed by: \_\_\_\_\_

# UNCONFINED COMPRESSIVE STRENGTH TEST

DA07720 - 300, SB - 2 @ 2' - 4' ( URS Corporation )

## NATURAL DRY DENSITY

Diameter (in.) = 2.68 in.  
Length (in.) = 3.58 in.  
Wet Weight (g) = 681.8 g

Soil Wt. = 1.50309 lb  
Area = 0.03917 ft<sup>2</sup>  
Volume = 0.01169 ft<sup>3</sup>  
Wet Density = 128.6 pcf

Dry Density = 112.6 pcf

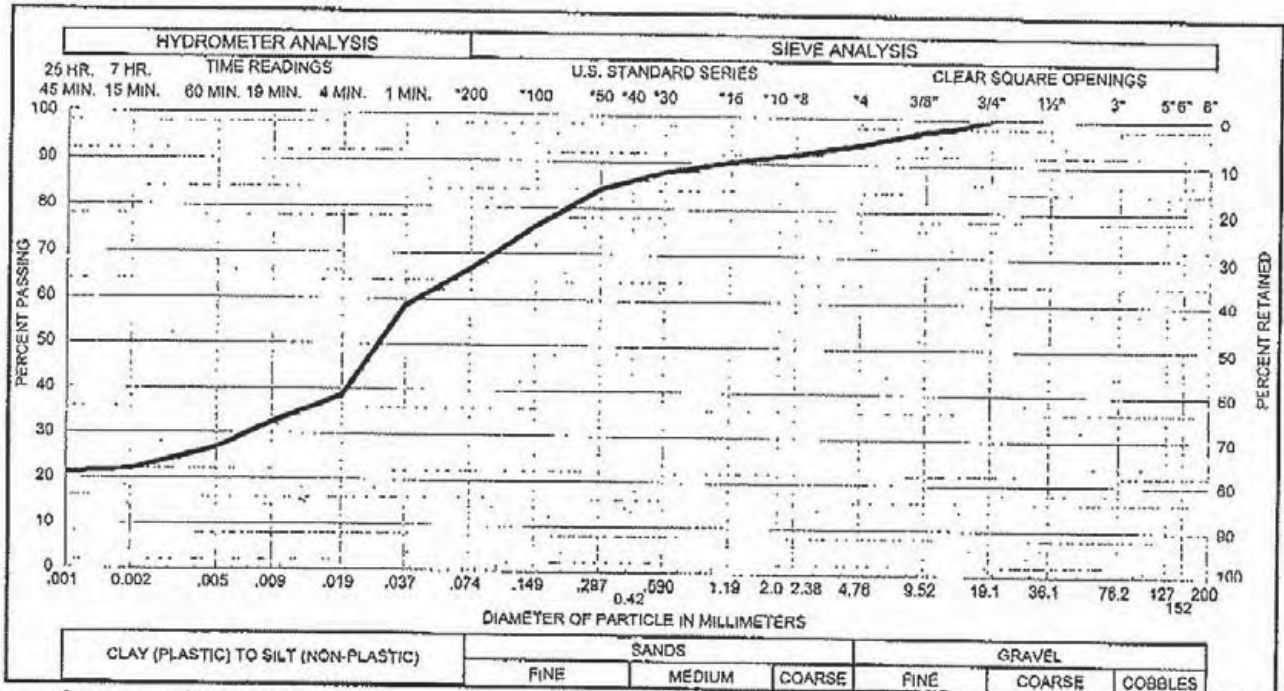
## MOISTURE CONTENT

Wet Soil & Dish Wt. = 346.31 g  
Dry Soil & Dish Wt. = 308.11 g  
Dish Wt. = 38.60 g

Moisture Content = 14.2 %

Load (lbs)	Strain Reading	Total Strain (%)	Corrected Stress (psf)
0	0	0	0
21	25	0.7	532
42	50	1.4	1057
64	75	2.1	1600
87	100	2.8	2159
108	125	3.5	2661
123	150	4.2	3008
135	175	4.9	3278
149	200	5.6	3591
172	250	7.0	4084
190	300	8.4	4444
203	350	9.8	4676
210	400	11.2	4762
212	450	12.6	4732
211	459	12.8	4696

2.38 TSF



Sample of SANDY CLAY, with gravel, light orangish brown  
 From SB - 1; 13' - 15'

CLAY (PLASTIC) TO SILT (NON-PLASTIC)	SANDS			GRAVEL			
	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLES	
				GRAVEL	6 %	SAND	27 %
				SILT & CLAY	67 %	LIQUID LIMIT	%
				PLASTICITY INDEX			%

### Gradation Test Results

NFCV( URS Corporation )

11656886.30000

Job No. DA07720 - 300( URS)



Figure : 1



# GRADATION ANALYSIS OF SOILS

DA07720 - 300 : SB - 1 ; 13' - 15' ( URS )

## NATURAL DRY DENSITY

Diameter (in.) = 3 in.

Length (in.) = 1 1/2 in.

Soil Wt. (g) = 271.04 g

Soil Wt. = 0 lb

Volume = 0 ft<sup>3</sup>

Wet Density = #DIV/0! pcf

Dry Density = #DIV/0! pcf

## MOISTURE CONTENT

Wet Soil & Dish Wt. = 311.65 g

Dry Soil & Dish Wt. = 271.04 g

Dish Wt. = 8.36 g

Water wt. = 40.6 g

Soil wt., W = 262.7 g

Moisture Content = 15.5 %

## COMPOSITE ANALYSIS

Wet wt. total sample: 311.65 g

Dry wt. total sample: 271.04 g

Total wt. passing No. 4:

Wet wt.:

Dry wt.:

Factor (F), (W%/W):

Sieve Size	Weight Retained, g	Weight Retained, lbs.	Weight Passing
3"			
1 1/2"			
1"			
3/4"	0.00		262.68
1/2"	5.27		257.41
3/8"	1.67		255.74
#4	7.58		248.16
#8	6.19		241.97
#16	4.83		237.14
#30	5.96		231.18
#50	10.07		221.11
#100	21.22		199.89
#200	24.86		175.03
Pan	0.07		
Total	87.72		

% of Total Passing
100.0
98.0
97.4
94.5
92.1
90.3
88.0
84.2
76.1
66.6

Dry wt. with dish after wash: 96.08

Dry wt. of sample sieved: 87.72

# PARTICLE SIZE ANALYSIS OF SOILS (ASTM D 422)

Tested By: k.m

Sheet No.: \_\_\_\_\_ Of \_\_\_\_\_

Date: 02 / 13 / 2007

Sample No.: \_\_\_\_\_

Job Number: DA0 7720-30

Test No.: \_\_\_\_\_

Job Name: NFCV (URS)

Location Of Sample: SB - 1 13-15

Description Of Sample: \_\_\_\_\_

Hydrometer No.: \_\_\_\_\_ Evaporating Dish No.: m-23

Cylinder No.: \_\_\_\_\_ Wt. Sample Dry + Dish: 271.04

Spec. Gr. Solids, SG: \_\_\_\_\_ Tare Weight: 8.36

Weight of Solids (gms): 50.00

02-13-07 10:47 AM

Date	Water Temp °F	Time	Elapsed Time	Suspension Reading $r_H$	Control Reading $r_c$	$R = \frac{H}{H} \frac{r - r_c}{c}$	D <sup>1</sup> (mm)	W <sub>D</sub> <sup>2</sup> %
2-13-07	68°F		0.5	54.0				
	"		1	49.0				
	"		2	41.2				
	"		4	34.1				
	"		8	31.2				
	"		19	29.5				
	"		30	27.6				
	"		60	25.2				
	"		120	23.7				
	"		435	21.5				
2-14	68°F		1545	20.8				

<sup>1</sup> Use Casagrande Hydrometer Nomograph.

<sup>2</sup> See ASTM 152H Calibration Handout.

Remarks: \_\_\_\_\_



HYDROMETER TEST

Wt. of sample (g): 262.68

Soil I.D.: SB - 1; 13' - 15'  
Job No: DA07720 - 300(URR)

Initial Moisture (%)

Wet Weight + Can...: 311.65  
Dry Weight + Can...: 271.04  
Weight of Water...: 40.61  
Tare Weight...: 8.36  
Weight of Dry Soil.: 262.68  
Moisture Content...: 15.46%

% Passing -200...: 66.60%

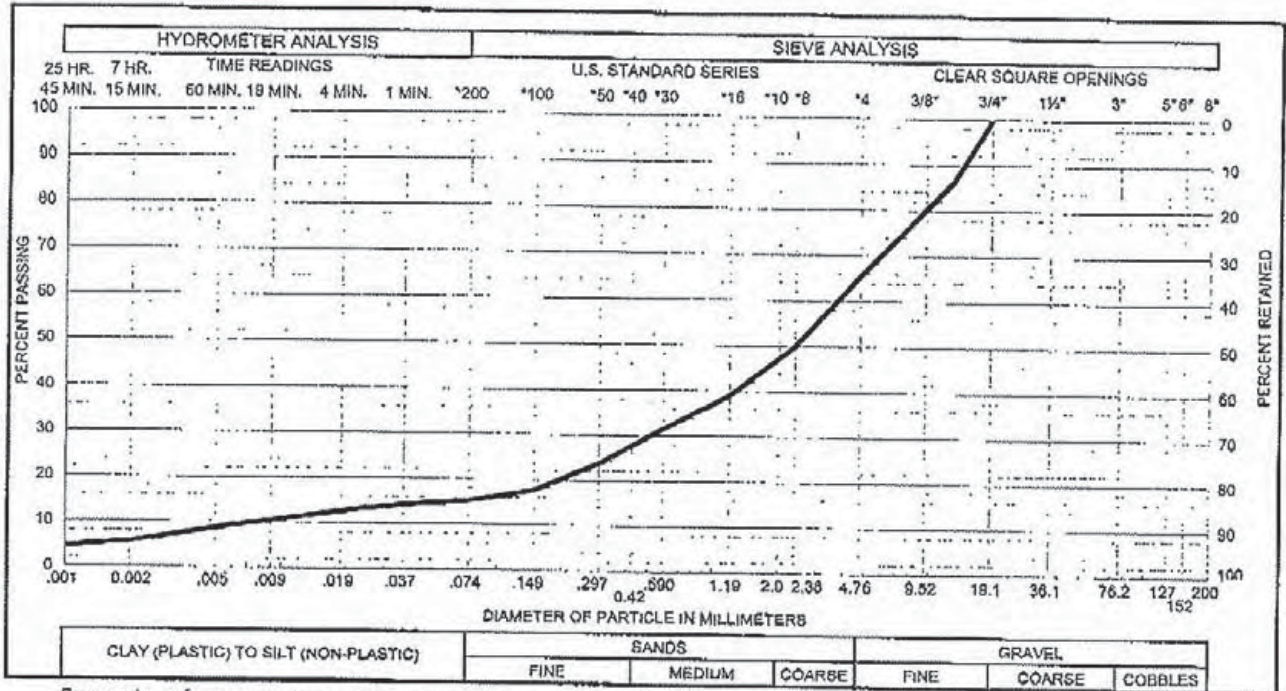
TIME IN SEDIMENTATION CYLINDER

Set-up Tim 10:47 AM  
Date.....: 02/13/07

Correct Factor.: 5 (measured at time of test)  
S.G. of Soil...: 2.68  
S.G. of Liquid.: 1.00  
Wt. of Dry Soil.: 50.00 g

Legend 1

Elapsed Time (min)	Hydrometer Reading in Cylinders	Control Reading	Corrected Hydrometer Reading	Temp. (deg F)	K	Particle Size (mm)	Soil in Suspension (%)	L	time	temp (C)
0.5	54.0	5.0	49.0	68	0.01365	0.0525	65.27	7.4	0.5	20
1	49.0	5.0	44.0	68	0.01365	0.0321	58.61	8.3	2	20
2	41.2	5.0	36.2	68	0.01365	0.0226	48.22	9.6	4	20
4	34.1	5.0	29.1	68	0.01365	0.0163	38.76	10.7	8	20
8	31.2	5.0	26.2	68	0.01365	0.0116	34.90	11.2	16	20
19	29.5	5.0	24.5	68	0.01365	0.0079	32.63	11.5	35	20
30	27.6	5.0	22.6	68	0.01365	0.0059	30.10	11.9	65	20
60	25.2	5.0	20.2	68	0.01365	0.0043	26.91	12.2	125	20
120	23.7	5.0	18.7	68	0.01365	0.0031	24.91	12.5	245	20
435	21.5	5.0	16.5	68	0.01365	0.0019	21.98	12.9	680	20
1545	20.8	5.0	15.8	68	0.01365	0.0010	21.05	13	2225	20



Sample of SAND, GRAVEL, with clay, light brown  
 From SB - 2; 18' - 20'

GRAVEL 35 % SAND 50 %  
 SILT & CLAY 15 % LIQUID LIMIT %  
 PLASTICITY INDEX %

### Gradation Test Results

NFCV( URS Corporation )

11656886.30000

Job No. DA07720 - 300( URS)

CTL THOMPSON

Figure : 2



# GRADATION ANALYSIS OF SOILS

DA07720 - 300 : SB - 2 ; 18' - 20' ( URS )

## NATURAL DRY DENSITY

Diameter (in.) = 4 in.

Length (in.) = 4 in.

Soil Wt. (g) = 208.9 g

Soil Wt. = 0 lb

Volume = 0 ft<sup>3</sup>

Wet Density = #DIV/0! pcf

Dry Density = #DIV/0! pcf

## MOISTURE CONTENT

Wet Soil & Dish Wt. = 239.11 g

Dry Soil & Dish Wt. = 217.38 g

Dish Wt. = 8.51 g

Water wt. = 21.7 g

Soil wt., W = 208.9 g

Moisture Content = 10.4 %

## COMPOSITE ANALYSIS

Wet wt. total sample:

Dry wt. total sample:

Total wt. passing No. 4:

Wet wt.:

Dry wt.:

Factor (F), (W%/W):

Sieve Size	Weight Retained, g	Weight Retained, lbs.	Weight Passing
3"			
1 1/2"			
1"			
3/4"	0.00		208.87
1/2"	28.62		180.25
3/8"	12.51		167.74
#4	30.87		136.87
#8	32.47		104.40
#16	22.71		81.69
#30	15.82		65.87
#50	16.24		49.63
#100	12.62		37.01
#200	4.98		32.03
Pan	0.07		
Total	176.91		

% of Total Passing
100.0
86.3
80.3
65.5
50.0
39.1
31.5
23.8
17.7
15.3

Dry wt. with dish after wash: 185.42

Dry wt. of sample sieved: 176.91

# PARTICLE SIZE ANALYSIS OF SOILS (ASTM D 422)

Tested By: k.m

Sheet No.: \_\_\_\_\_ Of \_\_\_\_\_

Date: 02/13/2007

Sample No.: \_\_\_\_\_

Job Number: DA0 7720-30

Test No.: \_\_\_\_\_

Job Name: NFCV (URS)

Location Of Sample: SB - 2 18-20

Description Of Sample: \_\_\_\_\_

Hydrometer No.: \_\_\_\_\_

Evaporating Dish No.: M-41

Cylinder No.: \_\_\_\_\_

Wt. Sample Dry + Dish: 239.11

Spec. Gr. Solids, SG: \_\_\_\_\_

Tare Weight: 8.51

02-13-07 10:59 AM.

Weight of Solids (gms): 30.00

Date	Water Temp °F	Time	Elapsed Time	Suspension Reading $r_H$	Control Reading $r_C$	$R = \frac{H}{H} \left( \frac{r - r_C}{r_C} \right)$	D <sup>1</sup> (mm)	W <sub>D</sub> <sup>2</sup> %
2-13-07	68°F		0.5	34.0				
	"		1	33.0				
	"		2	31.5				
	"		4	29.8				
	"		8	27.0				
	"		19	25.5				
	"		30	24.1				
	"		60	22.3				
	"		120	20.0				
	"		435	16.2				
2-14	68°F		1545	14.1				

<sup>1</sup> Use Casagrande Hydrometer Nomograph.

<sup>2</sup> See ASTM 152H Calibration Handout.

Remarks: \_\_\_\_\_

HYDROMETER TEST

Mt. of sample (g): 208.87

Soil I.D.: SB - 2; 18' - 20'  
Job No: DA07720 - 300(UFRS)

Initial Moisture (%)

Net Weight + Can...: 239.11  
Dry Weight + Can...: 217.38  
Weight of Water...: 21.73  
Tare Weight...: 8.51  
Weight of Dry Soil.: 208.87  
Moisture Content...: 10.40%

% Passing -200...: 15.30%

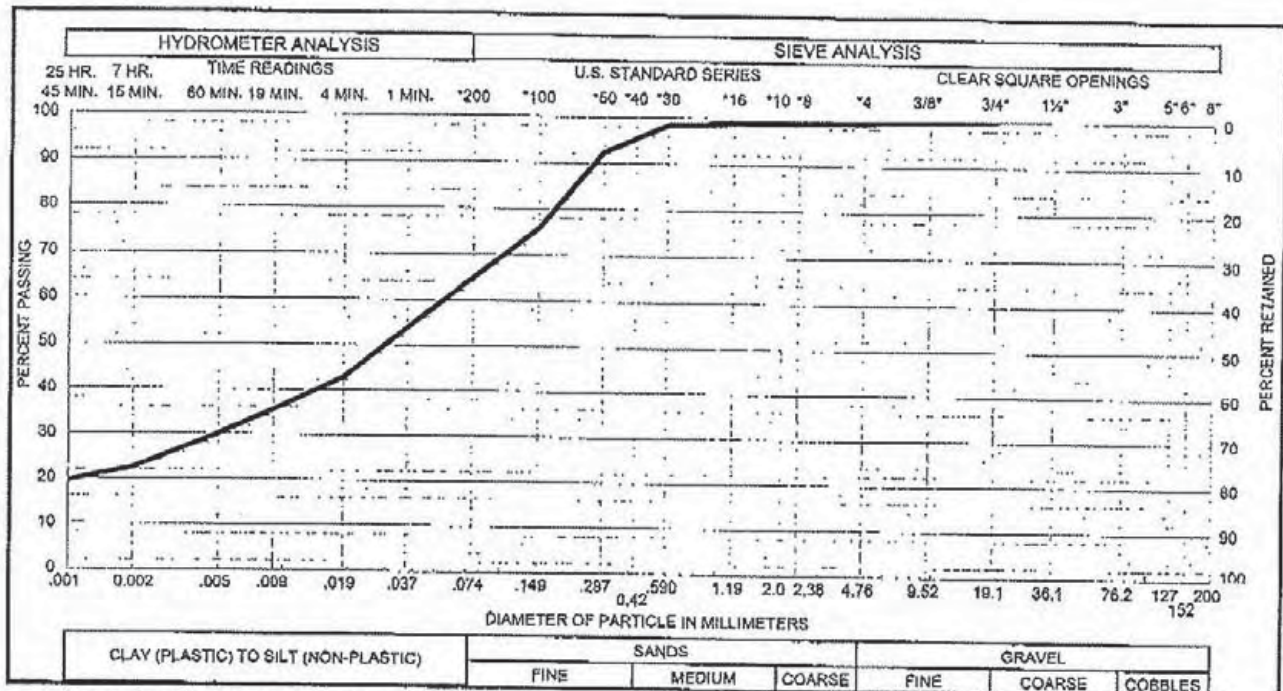
TIME IN SEDIMENTATION CYLINDER

Set-up Tim 10:59 AM  
Date.....: 02/13/07

Correct. Factor.: 5 (measured at time of test)  
S.G. of Soil...: 2.68  
S.G. of Liquid...: 1.00  
Wt. of Dry Soil.: 30.00 g

Legend 1

Elapsed Time (min)	Time (actual)	Hydrometer Reading in Cylinders	Control Reading	Corrected Hydrometer Reading	Temp. (deg F)	K	Particle Size (mm)	Soil in Suspension (%)	L	time	temp (C)
0.5		34.0	5.0	29.0	68	0.01365	0.0631	14.79	10.7	0.5	20
1		33.0	5.0	28.0	68	0.01365	0.0368	14.28	10.9	2	20
2		31.5	5.0	26.5	68	0.01365	0.0244	13.52	11.2	4	20
4		29.8	5.0	24.8	68	0.01365	0.0169	12.65	11.5	8	20
8		27.0	5.0	22.0	68	0.01365	0.0120	11.22	11.9	16	20
19		25.5	5.0	20.5	68	0.01365	0.0081	10.46	12.2	35	20
30		24.1	5.0	19.1	68	0.01365	0.0060	9.74	12.4	65	20
60		22.3	5.0	17.3	68	0.01365	0.0044	8.82	12.7	125	20
120		20.0	5.0	15.0	68	0.01365	0.0031	7.65	13	245	20
435		16.2	5.0	11.2	68	0.01365	0.0019	5.71	13.7	680	20
1545		14.1	5.0	9.1	68	0.01365	0.0011	4.84	14	2225	20



Sample of SANDY CLAY, light yellowish brown  
 From SB - 3 ; 8' - 10'

GRAVEL	1 %	SAND	34 %
SILT & CLAY	65 %	LIQUID LIMIT	%
PLASTICITY INDEX			%

**Gradation Test Results**  
 NFCV( URS Croporation )  
 11656996.30000

Job No. DA07720 - 300( URS)



Figure : 3

# GRADATION ANALYSIS HYDROMETER

Job No: DA07720 Hole No: SB-3 Depth: 8-10 Blow Count: \_\_\_\_\_

Job Name: URS Date: 02-09-07 Set Up By: SK/DM

Description: \_\_\_\_\_

Density	Moisture
Diameter: _____	Dish No: <u>M-87</u>
Length: _____	Dish/wet soil: <u>259.90</u>
Wet wt.: _____	Dish/dry soil: <u>237.18</u>
Dry wt.: _____	Dish wt.: <u>8.58</u>
Dry density: _____	Water wt.: _____
	Soil wt.: <u>W</u>
	Moisture %: <u>9.9</u>

Composite Analysis	
Wet wt. total sample:	_____
Dry wt. total sample:	_____
Total wt. passing No. 4:	_____
Wet wt.:	_____
Dry wt.:	_____
Factor (F), (W % / W):	_____

Sieve Size	Weight Retained, g	Weight Retained, lbs.	Weight Passing
5"			
3"			
1 1/2"			
1"			
3/4"			
1/2"			
3/8"	0.0		
No. 4	1.15		
No. 8	0.64		
No. 16	0.25		
No. 30	1.61		
No. 50	13.46		
No. 100	38.24		
No. 200	24.83		
Pan	0.06		
Total	80.26		

% Of Total Passing	Specifications	Particle Diam., mm
W%		4.750
		2.380
		1.190
		0.590
		0.297
		0.149
		0.074

Sieving time: \_\_\_\_\_  
 Dry wt. with dish after wash: 88.84  
 Dry wt. of sample sieved: 80.26

Remarks: \_\_\_\_\_

Sieved by: DM Calculated by: SRP Reviewed by: \_\_\_\_\_



# GRADATION ANALYSIS OF SOILS

DA07720 - 300 : SB - 3 ; 8' - 10' ( URS )

## NATURAL DRY DENSITY

Diameter (in.) = 2 in.

Length (in.) = 2 in.

Soil Wt. (g) = 80.26 g

Soil Wt. = 0 lb

Volume = 0 ft<sup>3</sup>

Wet Density = #DIV/0! pcf

Dry Density = #DIV/0! pcf

## MOISTURE CONTENT

Wet Soil & Dish Wt. = 259.90 g

Dry Soil & Dish Wt. = 237.18 g

Dish Wt. = 8.58 g

Water wt. = 22.7 g

Soil wt., W = 228.6 g

Moisture Content = 9.9 %

## COMPOSITE ANALYSIS

Wet wt. total sample: 259.90 g

Dry wt. total sample: 228.60 g

Total wt. passing No. 4:

Wet wt.:

Dry wt.:

Factor (F), (W%/W):

Sieve Size	Weight Retained, g	Weight Retained, lbs.	Weight Passing
3"			
1 1/2"			
1"			
3/4"			
1/2"			
3/8"	0.00		228.60
#4	1.15		227.45
#8	0.66		226.79
#16	0.25		226.54
#30	1.61		224.93
#50	13.46		211.47
#100	38.24		173.23
#200	24.83		148.40
Pan	0.06		
Total	80.26		

% of Total Passing
100.0
99.5
99.2
99.1
98.4
92.5
75.8
64.9

Dry wt. with dish after wash: 88.84

Dry wt. of sample sieved: 80.26

# PARTICLE SIZE ANALYSIS OF SOILS (ASTM D 422)

Tested By: km

Sheet No.: \_\_\_\_\_ Of \_\_\_\_\_

Date: 02 / 13 / 2007

Sample No.: \_\_\_\_\_

Job Number: DA0 7720-30

Test No.: \_\_\_\_\_

Job Name: NFCV (URS)

Location Of Sample: SB-3, 8-10

Description Of Sample: \_\_\_\_\_

Hydrometer No.: \_\_\_\_\_

Evaporating Dish No.: m-87

Cylinder No.: \_\_\_\_\_

Wt. Sample Dry + Dish: 237.15

Spec. Gr. Solids, SG: \_\_\_\_\_

Tare Weight: 8.58

02-13-07 11:17 AM

Weight of Solids (gms): 50.00

Date	Water Temp °F	Time	Elapsed Time	Suspension Reading $r_H$	Control Reading $r_c$	$R = \frac{H}{H} \left( \frac{r - r_c}{r_c} \right)$	D <sup>1</sup> (mm)	W <sub>D</sub> <sup>2</sup> %
2-13-07	68°F		0.5	53.0				
	"		1	46.5				
	"		2	40.3				
	"		4	38.0				
	"		8	35.5				
	"		19	32.4				
	"		30	29.8				
	"		60	28.2				
	"		120	26.1				
	"		435	22.3				
2-14	68°F		1545	20.1				

<sup>1</sup> Use Casagrande Hydrometer Nomograph.

<sup>2</sup> See ASTM 152H Calibration Handout.

Remarks: \_\_\_\_\_

HYDROMETER TEST

Wt. of sample (g): 228.60  
 Initial Moisture (%): 259.90  
 Soil I.D.: SB - 3; 8' - 10'  
 Job No: DA07720 - 300(URS)

Wet Weight + Can...: 237.18  
 Dry Weight + Can...: 22.72  
 Weight of Water...: 8.58  
 Tare Weight...: 228.60  
 Weight of Dry Soil.: 9.94%  
 Moisture Content...: 64.90%  
 % Passing -200...: 64.90%

TIME IN SEDIMENTATION CYLINDER

Set-up Tim 11:17 AM  
 Date: 02/13/07

Correct. Factor.: 5 (measured at time of test)  
 S.G. of Soil...: 2.68  
 S.G. of Liquid...: 1.00  
 Wt. of Dry Soil.: 50.00 g

Elapsed Time (min)	Time (actual)	Hydrometer Reading in Cylinders	Control Reading	Corrected Hydrometer Reading	Temp. (deg F)	K	Particle Size (mm)	Soil in Suspension (%)	L	time	temp (C)
0.5		53.0	5.0	48.0	68	0.01365	0.0532	62.30	7.6	0.5	20
1		46.5	5.0	41.5	68	0.01365	0.0331	53.87	8.8	2	20
2		40.3	5.0	35.3	68	0.01365	0.0227	45.82	9.7	4	20
4		38.0	5.0	33.0	68	0.01365	0.0158	42.83	10.1	8	20
8		35.5	5.0	30.5	68	0.01365	0.0113	39.59	10.6	16	20
19		32.4	5.0	27.4	68	0.01365	0.0077	35.57	11.1	35	20
30		29.8	5.0	24.8	68	0.01365	0.0058	32.19	11.5	65	20
60		28.2	5.0	23.2	68	0.01365	0.0042	30.11	11.7	125	20
120		26.1	5.0	21.1	68	0.01365	0.0030	27.39	12	245	20
435		22.3	5.0	17.3	68	0.01365	0.0019	22.46	12.7	680	20
1545		20.1	5.0	15.1	68	0.01365	0.0010	19.60	13	2225	20

CTL THOMPSON

TESTING PROGRAM

DA0720-300

Revised 6/25/04

JOB NO. 11656886.30000 (URS)  
JOB NAME AEGV  
ENGINEER

DATE RECEIVED  
DATE COMPLETED  
REVIEWED BY  
CHECKED BY

SHEET 1 OF 2

BORING NUMBER	SAMPLE NUMBER	SAMPLE DEPTH	TYPE OF SAMPLE	REMARKS	9085	3251	3250	3104	3220	3102	3103	3260	3270	3406	3230	3261	3282	3101	3290	3263	3232	3261	3267	3262	3320	3241	3271	3271	3412	3254	3285	4098					
					WATER CONTENT	SWELL	LOAD BACK	SWELL ONLY	HYDROMETRIC	ATTERBERG	GRADATION 1 INCH TO 200	-200 ONLY	UNCONFINED COMPRESSION	Q-TRIAXIAL	Q-DIRECT SHEAR	SULFATES	DENSITY	STD. PROCTOR	MOD. PROCTOR	GRADATION 5 TO 200	CBR	SUCTION	SPECIFIC GRAVITY	TIME CONSOLIDATION	NO. OF INCREMENTS	PERMEABILITY	UNCONFINED WITH STRESS / STRAIN C TRIAXIAL	CONSOLIDATION DIRECT SHEAR	CONSOLIDATION TRIAXIAL	RESISTIVITY	LIME SERIES PH	LIME SERIES AL	RESILIENT MODULUS				
1	58-1	0-2	ST		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				<input checked="" type="checkbox"/>																									<input checked="" type="checkbox"/>		
		2-4	ST		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>																															
		4-6	ST		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>																															
		6-8	ST		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>																															
		8-10	SS		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>																															
		13-15	SS		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>																															
		18-20	SS		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>																															
		0-2	ST		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>																															
		2-4	ST		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>																															
		4-6	SS		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>																															
		6-8	SS		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>																															
		8-10	SS		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>																															
		13-15	SS		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>																															
		18-20	SS		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>																															
					COMPUTER CLASSIFICATION																																
					TOTAL NUMBER OF TESTS																																
					TOTAL NUMBER OF CHARGEABLE TESTS																																



**ANALYTICAL RESULTS**  
**JUNE 2008**

**CTL | Thompson Texas,LLC**

JOB NUMBER: **DA08180 - 300**

DATE: **6/12/2008**

JOB NAME: **NFCU - FORT WORTH ( URS CORPORATION, INC. )**

<b>BORING</b>	<b>DEPTH (Feet)</b>	<b>MOISTURE (%)</b>	<b>UNIT DRY WT (PCF)</b>		<b>LIQUID LIMIT (%)</b>	<b>PLASTIC LIMIT (%)</b>	<b>PLASTICITY INDEX (PI)</b>	<b>COMP. STR (TSF)</b>	<b>STRAIN, %</b>
<b>SB - 1A</b>	<b>2 - 4</b>	<b>15.2</b>							
	<b>4 - 6</b>	<b>13.5</b>	<b>112.1</b>					<b>6.13</b>	<b>7.6</b>
<b>SB - 2</b>	<b>8 - 10</b>	<b>10.7</b>							
	<b>13 - 15</b>	<b>25.4</b>	<b>102.4</b>		<b>53</b>	<b>22</b>	<b>31</b>	<b>1.10</b>	<b>11.7</b>
	<b>18 - 20</b>	<b>29.5</b>							
<b>SB - 3</b>	<b>4 - 6</b>	<b>15.4</b>							
	<b>6 - 8</b>	<b>16.1</b>	<b>115.6</b>					<b>4.29</b>	<b>5.0</b>
	<b>8 - 10</b>	<b>16.4</b>	<b>117.0</b>		<b>54</b>	<b>22</b>	<b>32</b>	<b>6.11</b>	<b>6.7</b>

MOISTURE CONTENT - %PASSING#200 - PLASTICITY INDEX

JOB NUMBER: DAO

PROJECT NAME: N F C U - PORT WORTH - (CURS)

SET UP BY: SK/KOJ  
SET UP DATE: 06-05-08

TESTED BY: SK  
DATE TESTED: 06-01-08

MOISTURE CONTENT

MOISTURE CONTENT

LIQUID LIMITS

PLASTIC LIMITS

BORING NUMBER	DEPTH, FEET	TARE CAN NO.	TARE WEIGHT, gms.	WET + TARE, gms.	DRY + TARE, gms.	MOISTURE	TARE CAN NUMBER	TARE, gms.	AFTER WASH DRY TARE, gms.	PASSING #200	TARE CAN NUMBER	TARE, gms.	WET + TARE, gms.	DRY + TARE, gms.	BLOWS	LIQUID LIMITS	TARE CAN NUMBER	TARE, gms.	WET + TARE, gms.	DRY + TARE, gms.	PLASTIC LIMITS	PLASTIC INDEX			
SB-1A UC	2-4	50	37.61	39752	35015	15.2																			
																								SAMPLE DESCRIPTION	CLAY w/ Sand & Colmoids, Lt. yellowish Brown
UC	4-6	51	38.16	558	318.21	13.8																			
																								SAMPLE DESCRIPTION	CLAY w/ Sand & Colmoids, Gray & Lt. yellowish Brown
SB-2A PF UC	8-10	52	37.63	37847	245.43	10.7																			
																								SAMPLE DESCRIPTION	CLAY w/ Colmoids, yellowish Brown
																								SAMPLE DESCRIPTION	CLAY w/ Colmoids, Gray & Lt. yellowish Brown
UC	13-15	53	38.72	31106	255.90	25.4																			
																								SAMPLE DESCRIPTION	CLAY w/ Colmoids, Gray & Lt. yellowish Brown
																								SAMPLE DESCRIPTION	CLAY w/ Sand, Gray & Lt. yellowish Brown
UC	18-20	54	37.41	252.11	203.26	29.5																			
																								SAMPLE DESCRIPTION	CLAY w/ Sand, Gray & Lt. yellowish Brown
SB-3A UC	4-6	55	37.24	40168	352.93	15.4																			
																								SAMPLE DESCRIPTION	CLAY w/ Colmoids, Gray & Grayish Brown
UC	6-8	56	37.28	32368	287.50	16.1																			
																								SAMPLE DESCRIPTION	CLAY w/ Colmoids, Gray & Grayish Brown
PE UC	8-10	57	38.03	29609	259.75	16.4																			
																								SAMPLE DESCRIPTION	CLAY w/ Colmoids & Sand, Yellowish Brown
		SAMPLE DESCRIPTION																							



# UNCONFINED COMPRESSION TEST

Job No.: DA08180 HOLE: SB-1A DEPTH: 4-to-6  
 Job Name: NFCU - FORT WORTH (URS) DATE: 06-05-08

BLOW COUNT: \_\_\_\_\_

DATE: 06-06-08

Description: \_\_\_\_\_  
 \_\_\_\_\_

LOAD CELL NO.: \_\_\_\_\_

STRAIN in/min. \_\_\_\_\_

DIAMETER, in.: 2.79

Load (lbs)	Load On Specimen (psf)	Strain Reading	Unit Strain	Corrected Area	Total Strain (%)	Corrected Stress (psf)
0		0				
55		25				
90		50				
149		75				
216		100				
271		125				
305		150				
343		175				
372		200				
420		250				
470		300				
516		350				
541		400				
563		450			7.6	12260
560		500				
556		520				

**Density**

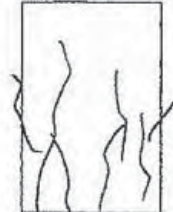
Length, in.: 5.96  
 Volume, cu. ft.: \_\_\_\_\_  
 Wet wt., g: 1216.58  
 Dry wt., g: \_\_\_\_\_  
 Dry density, pcf.: \_\_\_\_\_  
 Wet unit wt.: 129.2  
 Dry density, pcf.: 112.1

**Moisture**

Dish No. 61  
 Dish /soil wt., g: 355.88  
 Dish/dry soil, g: 318.21  
 Dish wt. g: 38.16  
 Water wt. g: \_\_\_\_\_  
 Dry soil wt., g: \_\_\_\_\_  
 Moisture %: 13.5  
 Saved for: \_\_\_\_\_

6013 T S F

Sketch



Unit strain = L/L      Corrected area = A/4 - Unit Strain

Tested by: SK/DH      Calculated by: km      Reviewed by: \_\_\_\_\_

# UNCONFINED COMPRESSIVE STRENGTH TEST

DA08180 - 300, SB - 1A @ 4' - 6'

### NATURAL DRY DENSITY

Diameter (in.) = 2.79 in.  
Length (in.) = 5.96 in.  
Wet Weight (g) = 1216.58 g

Soil Wt. = 2.68205 lb  
Area = 0.04246 ft<sup>2</sup>  
Volume = 0.02109 ft<sup>3</sup>  
Wet Density = 127.2 pcf

Dry Density = 112.1 pcf

### MOISTURE CONTENT

Wet Soil & Dish Wt. = 355.88 g  
Dry Soil & Dish Wt. = 318.21 g  
Dish Wt. = 38.16 g

Moisture Content = 13.5 %

Load (lbs)	Strain Reading	Total Strain (%)	Corrected Stress (psf)
0	0	0	0
55	25	0.4	1290
90	50	0.8	2102
149	75	1.3	3465
216	100	1.7	5002
271	125	2.1	6249
315	150	2.5	7233
343	175	2.9	7842
372	200	3.4	8468
428	250	4.2	9658
470	300	5.0	10513
516	350	5.9	11440
541	400	6.7	11887
563	450	7.6	12260
560	500	8.4	12084
556	520	8.7	11953

6.13 TSF.

# UNCONFINED COMPRESSION TEST

Job No.: DA08180 HOLE: SB-2A DEPTH: 13-to-15  
 Job Name: NFCU - FORT WORTH (URS) DATE: 06-05-08

BLOW COUNT: \_\_\_\_\_

DATE: 06-06-08

Description: \_\_\_\_\_

LOAD CELL NO.: \_\_\_\_\_

STRAIN in/min. \_\_\_\_\_

DIAMETER, in.: 2.80

Load (lbs)	Load On Specimen (psf)	Strain Reading	Unit Strain	Corrected Area	Total Strain (%)	Corrected Stress (psf)
0		0				
35		25				
50		50				
54		75				
59		100				
64		125				
67		150				
72		175				
76		200				
81		250				
87		300				
90		350				
93		400				
96		450				
97		500				
101		550				
104		600				
105		650				
107		700			11.7	22.09
108		750				
109		800				
109		850				
108		880				

### Density

Length, in.: 5.97

Volume, cu. ft.: \_\_\_\_\_

Wet wt., g: 1239.64

Dry wt., g: \_\_\_\_\_

Dry density, pcf.: \_\_\_\_\_

Wet unit wt.: 128.6

Dry density, pcf.: 102.4

### Moisture

Dish No. 53

Dish /soil wt., g: 311.06

Dish/dry soil, g: 255.90

Dish wt. g: 38.72

Water wt. g: \_\_\_\_\_

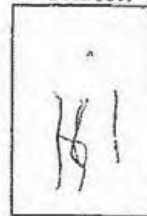
Dry soil wt., g: \_\_\_\_\_

Moisture %: 25.4

Saved for: \_\_\_\_\_

1.10 T S F

### Sketch



Unit strain = L/L

Corrected area = A/4 - Unit Strain

Tested by: SK/DH Calculated by: km Reviewed by: \_\_\_\_\_

# UNCONFINED COMPRESSIVE STRENGTH TEST

DA08180 - 300, SB - 2A @ 13' - 15'

## NATURAL DRY DENSITY

Diameter (in.) = 2.8 in.  
 Length (in.) = 5.97 in.  
 Wet Weight (g) = 1239.64 g

Soil Wt. = 2.73289 lb  
 Area = 0.04276 ft<sup>2</sup>  
 Volume = 0.02127 ft<sup>3</sup>  
 Wet Density = 128.5 pcf

Dry Density = **102.4 pcf**

## MOISTURE CONTENT

Wet Soil & Dish Wt. = 311.06 g  
 Dry Soil & Dish Wt. = 255.90 g  
 Dish Wt. = 38.72 g

Moisture Content = **25.4 %**

Load (lbs)	Strain Reading	Total Strain (%)	Corrected Stress (psf)
0	0	0	0
35	25	0.4	815
50	50	0.8	1160
54	75	1.3	1247
59	100	1.7	1357
64	125	2.1	1465
67	150	2.5	1527
72	175	2.9	1634
76	200	3.4	1718
81	250	4.2	1815
87	300	5.0	1932
90	350	5.9	1981
93	400	6.7	2029
96	450	7.5	2076
97	500	8.4	2078
101	550	9.2	2144
104	600	10.1	2188
105	650	10.9	2188
107	700	11.7	2209
108	750	12.6	2208
109	800	13.4	2207
109	850	14.2	2186
108	880	14.7	2153

1.1075F.

# UNCONFINED COMPRESSION TEST

Job No.: DA08180 HOLE: SB-3A DEPTH: 6-to-8

Job Name: NFCU - FORT WORTH (URS) DATE: 06-05-08

Description: \_\_\_\_\_  
\_\_\_\_\_

BLOW COUNT: \_\_\_\_\_

DATE: 06-06-08

LOAD CELL NO.: \_\_\_\_\_

STRAIN in/min. \_\_\_\_\_

DIAMETER, in.: 2.84

Load (lbs)	Load On Specimen (psf)	Strain Reading	Unit Strain	Corrected Area	Total Strain (%)	Corrected Stress (psf)
0		0				
34		25				
83		50				
124		75				
163		100				
194		125				
223		150				
257		175				
270		200				
356		250				
397		300			5.0	8570
360		350				
352		360				
341		370				

**Density**

Length, in.: 5.96  
 Volume, cu. ft.: \_\_\_\_\_  
 Wet wt., g: 1330.05  
 Dry wt., g: \_\_\_\_\_  
 Dry density, pcf.: \_\_\_\_\_  
 Wet unit wt.: 134.2  
 Dry density, pcf.: 115.6

**Moisture**

Dish No. 56  
 Dish /soil wt., g: 327.68  
 Dish/dry soil, g: 287.50  
 Dish wt. g: 37.28  
 Water wt. g: \_\_\_\_\_  
 Dry soil wt., g: \_\_\_\_\_  
 Moisture %: 16.1  
 Saved for: \_\_\_\_\_

4.29 T S F

Sketch



Unit strain = L/L

Corrected area = A/4 - Unit Strain

Tested by: SK/DH Calculated by: km Reviewed by: \_\_\_\_\_

# UNCONFINED COMPRESSIVE STRENGTH TEST

DA08180 - 300, SB - 3A @ 6' - 8'

## NATURAL DRY DENSITY

Diameter (in.) = 2.84 in.  
 Length (in.) = 5.96 in.  
 Wet Weight (g) = 1330.05 g

Soil Wt. = 2.93221 lb  
 Area = 0.04399 ft<sup>2</sup>  
 Volume = 0.02185 ft<sup>3</sup>  
 Wet Density = 134.2 pcf

Dry Density = **115.6 pcf**

## MOISTURE CONTENT

Wet Soil & Dish Wt. = 327.68 g  
 Dry Soil & Dish Wt. = 287.50 g  
 Dish Wt. = 37.28 g

Moisture Content = **16.1 %**

Load (lbs)	Strain Reading	Total Strain (%)	Corrected Stress (psf)
0	0	0	0
34	25	0.4	770
83	50	0.8	1871
124	75	1.3	2783
163	100	1.7	3643
194	125	2.1	4317
223	150	2.5	4942
257	175	2.9	5671
290	200	3.4	6371
356	250	4.2	7753
397	300	5.0	8570
360	350	5.9	7703
352	360	6.0	7518
341	370	6.2	7270

4-29 JSF

# UNCONFINED COMPRESSION TEST

Job No.: DA08180 HOLE: SB-3A DEPTH: 8-to-10

Job Name: NFCU-FORT WORTH (URS) DATE: 06-05-08

BLOW COUNT: \_\_\_\_\_

DATE: 06-06-08

Description: \_\_\_\_\_

LOAD CELL NO.: \_\_\_\_\_

STRAIN in/min. \_\_\_\_\_

DIAMETER, in.: 2.84

Load (lbs)	Load On Specimen (psf)	Strain Reading	Unit Strain	Corrected Area	Total Strain (%)	Corrected Stress (psf)
0		0				
45		25				
93		50				
139		75				
193		100				
211		125				
247		150				
300		175				
323		200				
414		250				
493		300				
549		350				
576		400			6.7	12218
560		450				
556		460				
540		470				

**Density**

Length, in.: 5.98

Volume, cu. ft.: \_\_\_\_\_

Wet wt., g: 1354.56

Dry wt., g: \_\_\_\_\_

Dry density, pcf.: \_\_\_\_\_

Wet unit wt.: 136.2

Dry density, pcf.: 117.0

**Moisture**

Dish No. 57

Dish /soil wt., g: 296.09

Dish/dry soil, g: 259.75

Dish wt. g: 38.03

Water wt. g: \_\_\_\_\_

Dry soil wt., g: \_\_\_\_\_

Moisture %: 16.4

Saved for: \_\_\_\_\_

6.11 T S F

**Sketch**



Unit strain = L/L

Corrected area = A/4 - Unit Strain

Tested by: SK/DH Calculated by: km Reviewed by: \_\_\_\_\_

# UNCONFINED COMPRESSIVE STRENGTH TEST

DA08180 - 300, SB - 3A @ 8' - 10'

## NATURAL DRY DENSITY

Diameter (in.) = 2.84 in.  
Length (in.) = 5.98 in.  
Wet Weight (g) = 1354.56 g

Soil Wt. = 2.98624 lb  
Area = 0.04399 ft<sup>2</sup>  
Volume = 0.02192 ft<sup>3</sup>  
Wet Density = 136.2 pcf

Dry Density = **117.0 pcf**

## MOISTURE CONTENT

Wet Soil & Dish Wt. = 296.09 g  
Dry Soil & Dish Wt. = 259.75 g  
Dish Wt. = 38.03 g

Moisture Content = **16.4 %**

Load (lbs)	Strain Reading	Total Strain (%)	Corrected Stress (psf)
0	0	0	0
45	25	0.4	1019
93	50	0.8	2096
139	75	1.3	3120
193	100	1.7	4314
211	125	2.1	4696
247	150	2.5	5474
300	175	2.9	6620
323	200	3.3	7097
414	250	4.2	9018
493	300	5.0	10645
549	350	5.9	11749
576	400	6.7	12218
566	450	7.5	11898
556	460	7.7	11667
540	470	7.9	11310

6.11 TSP



**CTL THOMPSON**

Revised 6/25/04

**TESTING PROGRAM**

JOB NO. DA08180-300  
 JOB NAME NFCU - Fort Worth (URS)  
 ENGINEER SD / LKF

DATE RECEIVED 06-04-08  
 DATE COMPLETED \_\_\_\_\_  
 REVIEWED BY \_\_\_\_\_  
 CHECKED BY \_\_\_\_\_

SHEET 1 OF 1

BORING NUMBER	SAMPLE NUMBER	SAMPLE DEPTH	TYPE OF SAMPLE	REMARKS	3095	3251	3250	3104	3220	3102	3103	3240	3270	3406	3230	3281	3282	3101	3290	3263	3232	3261	3262	3320	3241	3271	3412	3264	3265	4098	
SB-1A		4-6																													
		<del>2-4</del>																													
		<del>2-10</del>																													
		<del>2-15</del>																													
SB-2A		<del>4-6</del>																													
		<del>4-8</del>																													
		<del>4-10</del>																													
		<del>4-15</del>																													
SB-3A		8-10																													
		13-15																													
		18-20																													
		4-6																													
	6-8																														
	8-10																														
	<del>12-15</del>																														
	<del>18-20</del>																														
					3095	3251	3250	3104	3220	3102	3103	3240	3270	3406	3230	3281	3282	3101	3290	3263	3232	3261	3262	3320	3241	3271	3412	3264	3265	4098	
COMPUTER CLASSIFICATION																															
TOTAL NUMBER OF TESTS					8				2			4																			
TOTAL NUMBER OF CHARGEABLE TESTS																															

**NAVY FEDERAL CREDIT UNION**

**BID FORM**

**March 23, 2012**

**BRANCH:** For Navy Federal Credit Union – Fort Worth, Texas Branch Office (the “**Branch**”)

---

[*Name of bidding company*] (the “**Bidder**”) proposes, agrees and certifies as follows:

**I. SCOPE OF WORK; RECEIPT OF BID DOCUMENTS; NEGOTIATION**

- a) The Bidder will, if its Bid (defined below) is selected by Navy Federal Credit Union (“**NFCU**”) (i) furnish, provide and supply all labor, supervision, services, materials, items, equipment, and supplies (collectively, the “**Labor and Materials**”), and (ii) perform all work associated with the *new construction* of the Branch, all in strict accordance with the specifications, drawings, and NFCU’s form AIA A107 - 2007 contract (the “**Contract Form**”) previously delivered to the Bidder (such materials, the “**Bid Documents**”), as any of the same may be amended, modified or supplemented by NFCU or its Architect (collectively the “**Work**”).
- b) The Bidder acknowledges that it has received and reviewed the Bid Documents.
- c) The Bidder will, if selected by NFCU, enter into negotiations with NFCU to finalize a construction contract substantially in the form of the Contract Form. NFCU may cease negotiations with the Bidder at any time and for any reason until a contract is fully executed.

**II. LUMP SUM BID**

If selected by NFCU, the Bidder will provide and supply the Labor and Materials and undertake and complete the Work for the following lump sum price:

[\$  ]

The lump sum price listed above may not, in any circumstance, be increased, altered, or modified regardless of the actual cost of the Labor and Materials and/or the Work unless otherwise specified in the Contract Form or agreed to by NFCU in its sole discretion.

**III. BID DUE DATE; EFFECTIVENESS OF BID; CERTAIN BID REQUIREMENTS**

- a) The Bidder’s written bid (the “**Bid**”) must be received by **Schwarz-Hanson NO**

**LATER THAN 3:00 P.M. (CST) on March 23, 2012** (the “Closing Date”).  
You must send your Bid, and all required materials, to the following address:

**Schwarz-Hanson Architects  
Attn: Gerry Schwarz  
2570 River Park Plaza Suite 100  
Fort Worth, Texas 76116**

- b) The Bid will remain open and subject to acceptance by NFCU for **90 days** after bid opening or for such longer period of time as the Bidder may agree to in writing.
- c) Any Bids received after the time specified above will not be reviewed or considered. It is the Bidder's responsibility to confirm that their Bid was received.
- d) Bids must (i) be on this form, (ii) contain all required information, (iii) be typed or legibly handwritten, (iv) signed by an authorized representative of the Bidder, and (v) be securely sealed.
- e) NFCU reserves the right to issue supplements to this Bid Form or the Bid Documents prior to the Closing Date. NFCU will provide copies of any supplements to the contact person listed on the last page of this Bid Form. The Bidder will be required to address any supplements in order for its Bid to be considered by NFCU.

#### **IV. AWARD; REJECTION**

NFCU reserves the right, which it may exercise in its sole and absolute discretion, at any time and for any reason, to (i) accept any Bid, and (ii) reject any and all Bids. If all Bids are rejected by NFCU, NFCU will have the right to negotiate with the lowest bidder.

#### **V. PROJECT DURATION; COMPLETION; LIQUIDATED DAMAGES**

- a) All Work must be substantially completed within **151** days from the anticipated construction start date (which will be set forth in the Contract Form). The requirements for “substantial completion” are set forth in the Contract Form.
- b) Final completion of the Work will be completed within **14** from substantial completion.
- c) The Bidder acknowledges that (i) the Contract Form contains liquidated damages provisions that apply if certain conditions are not satisfied, and (ii) that those provisions have been reviewed and are acceptable.

#### **VI. REPRESENTATIONS**

The Bidder represents to NFCU that:

- a) it has visited the site of the Branch and become familiar with and is satisfied as to the general, local and site conditions that may affect cost, progress, and performance of the Labor and Materials and the Work;
- b) it is familiar with and is satisfied as to all applicable laws that may affect cost, progress and performance of the Labor and Materials and the Work;
- c) it does not consider that any further examinations, investigations, explorations, tests, studies or data are necessary for the determination of the Bidder's performance of the Work at the price(s) bid and within the times and in accordance with the other terms and conditions of the Bid Documents;
- d) it is aware of the general nature of work to be performed by NFCU or others designated by NFCU relating to the Branch, if any;
- e) it has given NFCU and its designated architect written notice of all conflicts, errors, ambiguities, or discrepancies that it has discovered in the Bid Documents and that those matters have been satisfactorily resolved;
- f) the Bid Documents are sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work for which the Bid is submitted.
- g) the below listed addendums have been received, examined and considered in connection with the Bidder's submission of its Bid:

Addendum No. \_\_\_\_\_ Date \_\_\_\_\_

Addendum No. \_\_\_\_\_ Date \_\_\_\_\_

Addendum No. \_\_\_\_\_ Date \_\_\_\_\_

Addendum No. \_\_\_\_\_ Date \_\_\_\_\_

- h) the Bid (i) is not a sham bid, (ii) has been authorized by all necessary actions of the Bidder, (iii) is a valid act of the Bidder, (iv) has not been submitted on behalf of any other party;
- i) it has not colluded, conspired, or agreed, directly or indirectly, with any other bidder, entity or person with respect to this Bid (including, without limitation, any matters relating to pricing, refusals or agreements to bid, or otherwise), and the Bidder has not directly or indirectly induced or solicited, or received any inducement or solicitation, from any other bidder to submit a false or sham bid;

- j) all statements, representations and certifications contained in the Bid are true and accurate; and
- k) it is registered as a general contractor in accordance with the laws and regulations of the State/ Commonwealth where the Branch is located.

## **VII. SPECIAL TERMS**

- a) The Bidder will, if selected by NFCU, and if required by any agreement entered into with NFCU, apply for and obtain, or if application has already been made, pick-up, any and all required permits for the Labor and Materials and/or the Work relating to the Branch.
- b) The Bidder acknowledges that, if selected, it will provide a warranty to NFCU as provided in the Contract Form.
- c) The Bidder acknowledges that, if selected, it will conduct post completion site evaluations of the Labor and Materials, the Work and the Branch at such times as provided in the Contract Form -- those evaluations will ensure, among other things, that the Labor and Materials, the Work and the Branch have remained free of deficiencies.
- d) The Bidder will, if selected by NFCU, submit all invoices within the time periods specified in the Contract Form.
- e) The Bidder acknowledges that it will, if selected by NFCU, be fully responsible for all of its employees, agents, subcontractors and other parties for which it is responsible, in accordance with the Contract Form.
- f) The Bidder has had the opportunity to, and has in fact, submitted any questions on this Bid Form and the Bid Documents to NFCU or the architect for the Branch selected by NFCU.
- g) NFCU will not provide reimbursement for any costs or expenses incurred in connection with any Bid or the preparation of any documents submitted with a Bid.
- h) To the fullest extent permitted by applicable law, all materials submitted with the Bid will become the property of NFCU and will not be returned. Bidders may not submit any materials to NFCU that they do not have the legal right to submit.

## **VIII. BID SECURITY**

The following security requirements must be complied with by each bidder: NONE.

## **IX. MANDATORY DOCUMENTS TO BE INCLUDED WITH A BID**

The following documents and items must be submitted for review with each Bid:

	<b>Document</b>	<b>Number of Pages</b>
A.	Construction Cost Breakdown Form which must be fully completed with a specified dollar amount for each item. If an item does not apply to this specific project, write "N/A". The form is not to be modified in any manner.	
B.	A complete breakdown of General Conditions indicated on the Cost Breakdown Form.	
C.	List of Proposed Subcontractors (once approved by NFCU, no changes shall be made without written approval of NFCU).	
D.	A copy of your standard subcontractor agreement which must be approved by NFCU.	
E.	Proof of insurance coverage (which must be on industry standard forms) in compliance with all requirements of Exhibit "C" to the Contract Form.	
F.	Clarifications & Exclusions (any allowances or exclusions in the Bid must be qualified and quantified).	

**X. CONFIDENTIALITY**

BIDDER AGREES THAT THE BID DOCUMENTS, AND ALL OTHER INFORMATION, DESIGNS, SCHEMATICS AND ITEMS THAT IT HAS RECEIVED RELATING TO THE BRANCH AND/OR NFCU (I) ARE FOR ITS SOLE AND EXCLUSIVE USE, ( II) ARE CONFIDENTIAL AND PROPRIETARY, AND (III) EXCEPT AS MAY BE REQUIRED BY APPLICABLE LAW OR REGULATION, MAY NOT BE RELEASED, DISTRIBUTED, TO ANY OTHER PARTY OR POSTED IN ANY PUBLIC FORMAT, INCLUDING, BUT NOT LIMITED TO, POSTINGS ON ANY PUBLIC WEBSITE, WITHOUT NFCU'S PRIOR CONSENT WHICH IT MAY WITHHOLD IN ITS SOLE DISCRETION. BY YOUR SUBMITTAL OF A BID, YOU ARE AGREEING THAT YOU WILL BE LIABLE TO NFCU FOR ANY DAMAGES IT MAY INCUR AS A RESULT OF ANY BREACH OF THIS PROVISION AND/OR THAT NFCU MAY SEEK, AND THAT YOU WILL NOT OBJECT TO, ANY INJUNCTIVE RELIEF WITH RESPECT TO SUCH BREACH.

**[BID SUBMITTAL SIGNATURE PAGE FOLLOWS]**

COMPANY NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_

STATE REGISTRATION NUMBER \_\_\_\_\_

STATE OF FORMATION OR LIST OF PARTNERS: \_\_\_\_\_

NAME OR AUTHORIZED SIGNATORY \_\_\_\_\_

SIGNATURE \_\_\_\_\_

TITLE \_\_\_\_\_

TELEPHONE NUMBER \_\_\_\_\_

FAX NUMBER \_\_\_\_\_

EMAIL ADDRESS \_\_\_\_\_

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





<b>5 Metals</b> Basic Metal Materials and Methods Structural Metal Framing Metal Joists Metal Deck Cold-Formed Metal Framing Metal Fabrications Hydraulic Fabrications Ornamental Metal Expansion Control Metal Restoration and Cleaning	
	<b>Subtotal</b>
<b>6 Wood and Plastic</b> Basic Wood and Plastic Materials and Methods Rough Carpentry Finish Carpentry Wood Trusses Architectural Woodwork Structural Plastics Plastics Fabrications Wood and Plastics Restoration and Cleaning	
	<b>Subtotal</b>
<b>7 Thermal &amp; Moisture Protection</b> Basic Thermal and Moisture Protection Materials Dampproofing and Waterproofing Thermal Protection Shingles, Roof Tiles, and Roof Coverings Roofing and Siding Panels Membrane Roofing Flashing and Sheet Metal Roof Specialties and Accessories Fire and Smoke Protection Joint Sealers	
	<b>Subtotal</b>
<b>8 Doors &amp; Windows</b> Basic Door and Window Materials and Methods Metal Doors and Frames Specialty Doors Entrances and Storefronts Windows Hardware Glazing Glazed Curtain Wall	
	<b>Subtotal</b>

<b>9 Finishes</b> Basic Finish Materials and Methods Metal Support Assemblies Plaster and Gypsum Board Tile Terrazzo Ceilings Flooring Wall Finishes Acoustical Treatment Paints and Coatings	
<b>Subtotal</b>	\$
<b>10 Specialties</b> Visual Display Boards Compartments and Cubicles Louvers and Vents Grilles and Screens Service Walls Wall and Corner Guards Access Flooring Pest Control Fireplaces and Stoves Manufactured Exterior Specialties Flagpoles Identification Devices Pedestrian Control Devices Lockers Fire Protection Specialties Protective Covers Postal Specialties Partitions Storage Shelving Exterior Protection Telephone Specialties Toilet, Bath, and Laundry Accessories Scales Wardrobe and Closet Specialties Strategic Supply, Global Solution for Healthier Environments:	
<b>Subtotal</b>	\$
<b>11 Equipment</b> Maintenance Equipment Security and Vault Equipment Teller and Service Equipment Audio-Visual Equipment Detention Equipment Hydraulic Gates and Valves Residential Appliances	
<b>Subtotal</b>	\$

<p><b>12 Furnishings</b>  Manufactured Casework  Furnishings and Accessories  Entrance Floor Mats and Frames</p>	
<p><b>21 Special</b>  Sound, Vibration, and Seismic Control  Lightning Protection  Pre-Engineered Structures  Storage Tanks  Building Automation and Control  Detection and Alarm  Fire Suppression</p>	
<p><b>22 Plumbing</b>  Basic Plumbing Materials and Methods  Plumbing Fixtures and Equipment</p>	
<p><b>23 Mechanical</b>  Basic Mechanical Materials and Methods  Building Services Piping  Process Piping  Fire Protection Piping  Plumbing Fixtures and Equipment  Heat-Generation Equipment  Refrigeration Equipment  Heating, Ventilating and Air Conditioning Equipment  Air Distribution  HVAC Instrumentation and Controls</p>	
<p><b>26 Electrical</b>  Basic Electrical Materials and Methods  Wiring Methods  Electrical Power  Transmission and Distribution  Low-Voltage Distribution  Lighting - Interior  Lighting - Exterior  Communications  Sound and Video  Electronic Safety and Security</p>	
<p><b>28 Electronic Safety and Security</b>  Addressable Fire-Alarm System</p>	

Subtotal

TOTAL LUMP SUM PRICE

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
  - 1. Project information.
  - 2. Work covered by Contract Documents.
  - 3. Work by Owner.
  - 4. Work under separate contracts.
  - 5. Owner-furnished products.
  - 6. Contractor-furnished, Owner-installed products.
  - 7. Access to site.
  - 8. Work restrictions.
  - 9. Specification and drawing conventions.

1.3 PROJECT INFORMATION

- A. Project Identification: Navy Federal Credit Union, Fort Worth Branch  
Project Location: 6400 Westworth BLVD., City of Westworth Village, Texas 76114
- B. Owner: Navy Federal Credit Union 820 Follin Lane Vienna, VA 22180
  - 1. Owner's Representative: Brian Murphy
- C. Architect/Engineer (A/E): Schwarz-Hanson Architects - 2570 River Park Plaza Suite 100  
Fort Worth, TX 76116
  - 1. A/E's project architect: Gerry H. Schwarz AIA
- D. Other Owner Consultants: The Owner has retained the following design professionals who have prepared designated portions of the Contract Documents:
  - 1. Civil Engineering: URS Corporation has prepared the following documents:
    - a. Civil/Site bid package (drawings and specifications).
- E. Project Website: A project FTP site administered by the A/E will be used for purposes of managing communication and documents during the construction stage.

1. See Division 01 Section “Project Management and Coordination” for requirements for using the website.

#### 1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and consists of the following:

1. Project Manual (specifications) and Drawings.

- B. Type of Contract:

1. Project will be constructed under a single prime contract.

#### 1.5 WORK BY OWNER

- A. General: Cooperate fully with Owner so work may be carried out smoothly, without interfering with or delaying work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.

- B. Concurrent Work: Owner will perform the following construction operations at Project site. Those operations will be conducted simultaneously with work under this Contract.

1. Installation of owner furnished banking equipment (except pneumatic tube system).
2. Installation of owner furnished security and Tele/Com Systems: Owner furnished furniture and equipment.

#### 1.6 WORK UNDER SEPARATE CONTRACTS

- A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract or other contracts. Coordinate the Work of this Contract with work performed under separate contracts.

- B. Concurrent Work: Owner will award separate contract for the following construction operations at Project site. Those operations will be conducted simultaneously with work under this Contract.

1. Signage Contract: Exterior signage contract is with Identity Management. Interior signage contract is with Concepts Unlimited.

#### 1.7 OWNER-FURNISHED PRODUCTS

- A. Owner will furnish products indicated on the drawings. The Work includes receiving, unloading, handling, storing, protecting, and installing Owner-furnished products and making building services connections.

## 1.8 CONTRACTOR-FURNISHED, OWNER-INSTALLED PRODUCTS

- A. Contractor shall furnish products indicated. The Work includes receiving, unloading, handling, storing, and protecting Contractor-furnished products and turning them over to Owner as directed
- B. Contractor-Furnished, Owner-Installed Products:
  - 1. Code Locks: (HW2) Networkx by Trilogy – Electric pushbutton locks.

## 1.9 ACCESS TO SITE

- A. General: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.
- B. General: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.
- C. Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
  - 1. Limits: Limit site disturbance, including earthwork and clearing of vegetation, to 40 feet (12.2 m) beyond building perimeter; 10 feet (3 m) beyond surface walkways, patios, surface parking, and utilities less than 12 inches (300 mm) in diameter; 15 feet (4.5 m) beyond primary roadway curbs and main utility branch trenches; and 25 feet (7.6 m) beyond constructed areas with permeable surfaces (such as pervious paving areas, stormwater detention facilities, and playing fields) that require additional staging areas in order to limit compaction in the constructed area.
  - 2. Driveways, Walkways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
    - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
    - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

## 1.10 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
  - 1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.



1.11 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
  - 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
  - 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
  - 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
  - 2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

## **SECTION 011100 - FIELD ENGINEERING**

### **PART 1 - GENERAL**

#### **1.1 SCOPE OF WORK**

- A. Work described in this section includes Contractor's responsibilities for verifying existing grades indicated on the drawings, establishing and maintaining bench marks and reference lines, laying out buildings and appurtenances and coordinating locations of various trades' work within the project site.

#### **1.2 QUALITY CRITERIA**

- A. Contractor shall perform the following:
  - 1. Verify existing grades prior to beginning site preparation. If existing grades are at variance with drawings, notify the Owner's Representative and receive instruction prior to proceeding.
  - 2. Verify limits of site preparation and earthwork operations. Locate adjacent buildings, appurtenances and trees to remain.
  - 3. Establish benchmarks outside building lines. Establish two benchmarks, located on the project site, as widely separated as possible.
  - 4. Verify location and elevation of buildings.
  - 5. Verify utility locations, including new construction and existing active and inactive encountered during construction activity. Coordinate all utility work with the appropriate utility authority.
  - 6. Verify outside building lines to ensure correct position of buildings and appurtenances on the project site.
  - 7. Coordinate work of all trades.
- B. During the course of the Work, prepare a log containing all data observed as a result of field engineering. Maintain a log for reference by the Owner's Representative and Engineer.
- C. Notify Engineer, in writing, of on-site conditions that are at variance with the Contract Documents. Compare variations in locations, level, plumbness and deflection with allowable tolerance given in the Contract Documents.

**End of Section 011100**

## SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

### 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 administrative and procedural requirements for handling and processing Contract modifications.

#### 1.3 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time on AIA Document G 710, "Architect's Supplemental Instructions."

#### 1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
  - 1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
  - 2. Within 10 days after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
    - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
    - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    - c. Include costs of labor and supervision directly attributable to the change.
    - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
  - 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
  - 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
  - 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
  - 4. Include costs of labor and supervision directly attributable to the change.
  - 5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
  - 6. Proposal Request Form: Use form acceptable to Architect.

#### 1.5 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Changes Proposal Request, Contractor will issue a Change Order for review by the A/E and signatures of Owner and Contractor on AIA Document G701.

#### 1.6 CONSTRUCTION CHANGE DIRECTIVE (CCD)

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs the Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
  - 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
  - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.
  - 2. Cost and time adjustments to the Contract necessitated by Construction Change Directive shall be made via subsequent Change Order.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

## SECTION 012900 - PAYMENT PROCEDURES

### 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 administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
  - 1. Division 01 Section "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
  - 2. Division 01 Section "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

#### 1.3 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

#### 1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule. Critical Path Method Schedule may serve to satisfy requirements for the schedule of values.
  - 1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:
    - a. Application for Payment forms with continuation sheets.
    - b. Submittal schedule.
    - c. Items required to be indicated as separate activities in Contractor's construction schedule.
  - 2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.

- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
1. Identification: Include the following Project identification on the schedule of values:
    - a. Project name and location.
    - b. Name of Architect.
    - c. Architect's project number.
    - d. Contractor's name and address.
    - e. Date of submittal.
  2. Arrange schedule of values consistent with format of AIA Document G703.
  3. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:
    - a. Related Specification Section or Division.
    - b. Description of the Work.
    - c. Change Orders (numbers) that affect value.
    - d. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
      - 1) Labor.
      - 2) Materials.
      - 3) Equipment.
  4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
  5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
  6. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
    - a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.
  7. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
  8. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
  9. Purchase Contracts: Provide a separate line item in the schedule of values for each purchase contract. Show line-item value of purchase contract. Indicate owner payments or deposits, if any, and balance to be paid by Contractor.
  10. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

- a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.
11. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

## 1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
  1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Payment Application Times: Submit Application for Payment to Architect by the 30<sup>th</sup> of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.
  1. Submit draft copy of Application for Payment seven days prior to due date for review by Architect.
- D. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
- E. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
  1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
  2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
  3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
  4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- F. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
  1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.

2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
  3. Provide summary documentation for stored materials indicating the following:
    - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
    - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
    - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- G. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- H. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
  2. When an application shows completion of an item, submit conditional final or full waivers.
  3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
  4. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- I. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
  2. When an application shows completion of an item, submit conditional final or full waivers.
  3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
  4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
  5. Waiver Forms: Submit executed waivers of lien on forms, acceptable to Owner.
- J. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
  2. Schedule of values.



3. Contractor's construction schedule (preliminary if not final).
  4. Submittal schedule (preliminary if not final).
  5. List of Contractor's staff assignments.
  6. List of Contractor's principal consultants.
  7. Copies of building permits.
  8. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
  9. Initial progress report.
  10. Report of preconstruction conference.
  11. Certificates of insurance and insurance policies.
  12. Performance and payment bonds.
  13. Data needed to acquire Owner's insurance.
- K. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
  2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- L. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
  2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
  3. Updated final statement, accounting for final changes to the Contract Sum.
  4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
  5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
  6. AIA Document G707, "Consent of Surety to Final Payment."
  7. Evidence that claims have been settled.
  8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
  9. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

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 administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
  - 1. General coordination procedures.
  - 2. Requests for Information (RFIs).
  - 3. Project meetings.
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.
- C. Related Requirements:
  - 1. Division 01 Section "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
  - 2. Division 01 Section "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
  - 3. Division 01 Section "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

- A. RFI: Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

- A. Key Personnel Names: Within 15 days of execution of the Agreement, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
  - 1. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

## 1.5 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.
  - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
  - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
  - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
  - 1. Preparation of Contractor's construction schedule.
  - 2. Preparation of the schedule of values.
  - 3. Installation and removal of temporary facilities and controls.
  - 4. Delivery and processing of submittals.
  - 5. Progress meetings.
  - 6. Project closeout activities.
  - 7. Startup and adjustment of systems.
- C. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
  - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

## 1.6 REQUESTS FOR INFORMATION (RFIs)

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
  - 1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
  - 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
  - 1. Project name.
  - 2. Project number.
  - 3. Date.

4. Name of Contractor.
  5. Name of Architect.
  6. RFI number, numbered sequentially.
  7. RFI subject.
  8. Specification Section number and title and related paragraphs, as appropriate.
  9. Drawing number and detail references, as appropriate.
  10. Field dimensions and conditions, as appropriate.
  11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
  12. Contractor's signature.
  13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
    - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.
1. Attachments shall be electronic files in Adobe Acrobat PDF format.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow 5 working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
1. The following Contractor-generated RFIs will be returned without action:
    - a. Requests for approval of submittals.
    - b. Requests for approval of substitutions.
    - c. Requests for approval of Contractor's means and methods.
    - d. Requests for coordination information already indicated in the Contract Documents.
    - e. Requests for adjustments in the Contract Time or the Contract Sum.
    - f. Requests for interpretation of Architect's actions on submittals.
    - g. Incomplete RFIs or inaccurately prepared RFIs.
  2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
  3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 01 Section "Contract Modification Procedures."
    - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log Bi-Weekly. Include the following:
1. Project name.

2. Name and address of Contractor.
3. Name and address of Architect.
4. RFI number including RFIs that were returned without action or withdrawn.
5. RFI description.
6. Date the RFI was submitted.
7. Date Architect's response was received.

F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within 3 days if Contractor disagrees with response.

1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
2. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

## 1.7 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within 3 days of the meeting.

B. Preconstruction Conference: Contractor shall schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.

1. Conduct the conference to review responsibilities and personnel assignments.
2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect progress, including the following:
  - a. Tentative construction schedule.
  - b. Critical work sequencing and long-lead items.
  - c. Designation of key personnel and their duties.
  - d. Lines of communications.
  - e. Procedures for processing field decisions and Change Orders.
  - f. Procedures for RFIs.
  - g. Procedures for testing and inspecting.
  - h. Procedures for processing Applications for Payment.
  - i. Distribution of the Contract Documents.

- j. Submittal procedures.
  - k. Preparation of record documents.
  - l. Use of the premises.
  - m. Work restrictions.
  - n. Working hours.
  - o. Owner's occupancy requirements.
  - p. Responsibility for temporary facilities and controls.
  - q. Procedures for moisture and mold control.
  - r. Procedures for disruptions and shutdowns.
  - s. Construction waste management and recycling.
  - t. Parking availability.
  - u. Office, work, and storage areas.
  - v. Equipment deliveries and priorities.
  - w. First aid.
  - x. Security.
  - y. Progress cleaning.
4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

C. Progress Meetings: Conduct progress meetings at monthly intervals.

- 1. Coordinate dates of meetings with preparation of payment requests.
- 2. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
- 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
  - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
    - 1) Review schedule for next period.
  - b. Review present and future needs of each entity present, including the following:
    - 1) Interface requirements.
    - 2) Sequence of operations.
    - 3) Status of submittals.
    - 4) Deliveries.
    - 5) Off-site fabrication.
    - 6) Access.
    - 7) Site utilization.
    - 8) Temporary facilities and controls.

- 9) Progress cleaning.
  - 10) Quality and work standards.
  - 11) Status of correction of deficient items.
  - 12) Field observations.
  - 13) Status of RFIs.
  - 14) Status of proposal requests.
  - 15) Pending changes.
  - 16) Status of Change Orders.
  - 17) Pending claims and disputes.
  - 18) Documentation of information for payment requests.
4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
- a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

## SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

### 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 administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
  - 1. Contractor's construction schedule.
  - 2. Construction schedule updating reports.
  - 3. Daily construction reports.
  - 4. Material location reports.
  - 5. Site condition reports.
  - 6. Special reports.
- B. Related Requirements:
  - 1. Division 01 Section "Submittal Procedures" for submitting schedules and reports.
  - 2. Division 01 Section "Quality Requirements" for submitting a schedule of tests and inspections.

#### 1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
  - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
  - 2. Predecessor Activity: An activity that precedes another activity in the network.
  - 3. Successor Activity: An activity that follows another activity in the network.
- B. Event: The starting or ending point of an activity.
- C. Float: The measure of leeway in starting and completing an activity.
  - 1. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
  - 2. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.



#### 1.4 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
  - 1. Working electronic copy of schedule file, where indicated.
  - 2. PDF electronic file.
  - 3. 4 paper copies.
- B. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
  - 1. Submit a working electronic copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.
- C. Construction Schedule Updating Reports: Submit with Applications for Payment.
- D. Daily Construction Reports (with photographs): Submit at weekly intervals.
- E. Material Location Reports: Submit at monthly intervals.
- F. Site Condition Reports: Submit at time of discovery of differing conditions.
- G. Special Reports: Submit at time of unusual event.

#### 1.5 QUALITY ASSURANCE

- A. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's construction schedule, including, but not limited to, the following:
  - 1. Review software limitations and content and format for reports.
  - 2. Verify availability of qualified personnel needed to develop and update schedule.
  - 3. Discuss constraints, including milestones.
  - 4. Review delivery dates for Owner-furnished products.
  - 5. Review schedule for work of Owner's separate contracts.
  - 6. Review submittal requirements and procedures.
  - 7. Review time required for review of submittals and resubmittals.
  - 8. Review requirements for tests and inspections by independent testing and inspecting agencies.
  - 9. Review time required for Project closeout and Owner startup procedures.
  - 10. Review and finalize list of construction activities to be included in schedule.
  - 11. Review procedures for updating schedule.

#### 1.6 COORDINATION

- A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

- B. Coordinate Contractor's construction schedule with the schedule of values submittal schedule, progress reports, payment requests, and other required schedules and reports.
  - 1. Secure time commitments for performing critical elements of the Work from entities involved.
  - 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

## PART 2 - PRODUCTS

### 2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for the commencement of the Work to date of final completion.
  - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- B. Activities: Treat each story or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
  - 1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
  - 2. Submittal Review Time: Include review and resubmittal times indicated in Division 01 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
  - 3. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
  - 4. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
  - 5. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.
- C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
  - 1. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
    - a. Structural completion.
    - b. Temporary enclosure and space conditioning.
    - c. Permanent space enclosure.
    - d. Completion of mechanical installation.
    - e. Completion of electrical installation.
    - f. Substantial Completion.

- D. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.
- E. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
  - 1. Use Microsoft Project or Primavera, for Windows operating system.

## 2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's construction schedule within 15 days of date established for the Notice to Proceed. Base schedule on the startup construction schedule and additional information received since the start of Project.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.

## 2.3 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

- A. General: Prepare network diagrams using AON (activity-on-node) format.
- B. Startup Network Diagram: Submit diagram within 14 days of date established for commencement of the Work. Outline significant construction activities for the first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.
- C. CPM Schedule: Prepare Contractor's construction schedule using a time-scaled CPM network analysis diagram for the Work.
  - 1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 60 days after date established for commencement of the Work.
    - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.
  - 2. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
  - 3. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule in order to coordinate with the Contract Time.
- D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.

1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
  - a. Preparation and processing of submittals.
  - b. Mobilization and demobilization.
  - c. Purchase of materials.
  - d. Delivery.
  - e. Fabrication.
  - f. Utility interruptions.
  - g. Installation.
  - h. Work by Owner that may affect or be affected by Contractor's activities.
  - i. Testing.
  - j. Punch list and final completion.
  - k. Activities occurring following final completion.
  
2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
  - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
  
- E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall project schedule.
  
- F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
  1. Contractor or subcontractor and the Work or activity.
  2. Description of activity.
  3. Main events of activity.
  4. Immediate preceding and succeeding activities.
  5. Early and late start dates.
  6. Early and late finish dates.
  7. Activity duration in workdays.
  8. Total float or slack time.
  9. Average size of workforce.
  10. Dollar value of activity (coordinated with the schedule of values).
  
- G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
  1. Identification of activities that have changed.

2. Changes in early and late start dates.
3. Changes in early and late finish dates.
4. Changes in activity durations in workdays.
5. Changes in the critical path.
6. Changes in total float or slack time.
7. Changes in the Contract Time.

## 2.4 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
1. List of subcontractors at Project site.
  2. Approximate count of personnel at Project site.
  3. Equipment at Project site.
  4. Material deliveries.
  5. High and low temperatures and general weather conditions, including presence of rain or snow.
  6. Accidents.
  7. Meetings and significant decisions.
  8. Unusual events (see special reports).
  9. Stoppages, delays, shortages, and losses.
  10. Meter readings and similar recordings.
  11. Emergency procedures.
  12. Orders and requests of authorities having jurisdiction.
  13. Change Orders received and implemented.
  14. Construction Change Directives received and implemented.
  15. Services connected and disconnected.
  16. Equipment or system tests and startups.
  17. Partial completions and occupancies.
  18. Substantial Completions authorized.
  19. 3 to 5 photographs of significant work milestones (daily).
- B. Daily construction reports and supporting photographs shall be submitted each Monday for the previous work week.
- C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

## 2.5 SPECIAL REPORTS

- A. General: Submit special reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.
- B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of

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results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

### PART 3 - EXECUTION

#### 3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
  - 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
  - 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
  - 3. As the Work progresses, indicate final completion percentage for each activity.
- B. Distribution: Distribute copies of approved schedule to Architect Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
  - 1. Post copies in Project meeting rooms and temporary field offices.
  - 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 013200

## SECTION 013201 - MATERIAL AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 DELIVERY, STORAGE AND HANDLING

- A. Requirements of this section are general in nature. Refer to individual specification sections for additional specific requirements.
- B. Deliver manufactured products to project site in manufacturer's original packaging with labels and seals intact. Labels shall indicate manufacturer and product name, description, mixing and application instructions. Where applicable, labels shall indicate fire resistive classifications.
- C. Inspect materials upon delivery to ensure proper material, color, type and quantity.
- D. Store materials and equipment under cover, off ground at least 6 inches and protected from excessive heat and freezing, except for materials not subject to damage or deterioration by contact with environmental conditions. Observe manufacturer's recommendations for positioning, separation and ventilation, as applicable.
- E. Prevent corrosion, soiling or breakage of materials or contact with deleterious materials.
- F. Deliver finish materials only after spaces are enclosed and adequate indoor storage facilities are available. Deliver items such as millwork only after spaces approximate completed conditions.
- G. Handle materials and equipment to prevent damage, deterioration, or contamination. Install no materials that are physically damaged or stained prior to time for installation.
- H. Store and handle paints and products subject to spillage in areas where spills will not deface finished surfaces or other work.
- I. Flammable or hazardous materials:
  - 1. Store minimum quantities in protected areas.
  - 2. Provide appropriate type fire extinguisher near storage areas.
  - 3. Observe manufacturer's precautions and applicable ordinances and regulations.
- J. Comply with manufacturer's instructions and recommendations for product storage and handling.
- K. Comply with manufacturer's product data in all aspects of basic material usage, handling, installation and substrate preparation, except where more stringent requirements are specified.

#### 1.2 MATERIALS CONTAINING HAZARDOUS SUBSTANCES

- A. The intent of the Contract Documents is to exclude all materials which contain known hazardous substances, including materials containing asbestos, polychlorinated biphenyl (PCB), or any other known substances determined to be a health hazard by the United States Environmental Protection Agency (EPA) and other recognized agencies. In studying the Contract Documents and at any time during execution of the Work, the Contractor shall at once report to the Owner's Representative any materials containing hazardous substances that he may discover. Do not proceed with installation of materials containing known hazardous substances.
- B. Where products are specified by reference standard or in descriptive manner without manufacturer's name,

model number or trade name, Contractor shall select materials meeting specified requirements which do not contain hazardous substances in any form.

- C. In making requests for substitutions, Contractor shall be responsible for determining that materials requested for substitution are free of hazardous substances in any form.

**End of Section 013201**



## SECTION 013300 - SUBMITTAL PROCEDURES

### 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 requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. Related Requirements:
  - 1. Division 01 Section "Payment Procedures" for submitting Applications for Payment and the schedule of values.
  - 2. Division 01 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
  - 3. Division 01 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.

#### 1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."
- C. Concurrent Submittals: Action submittals that are reviewed by the owner and A/E simultaneously. Owner and A/E comments will be combined before being returned.

#### 1.4 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 additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
2. Format: Arrange the following information in a tabular format:
  - a. Scheduled date for first submittal.
  - b. Specification Section number and title.
  - c. Submittal category: Action; informational.
  - d. Name of subcontractor.
  - e. Description of the Work covered.

## 1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. 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. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
  3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
  4. 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 reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- B. 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 7 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect 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 7 days for review of each resubmittal.
  4. Concurrent Review: Where the Contract Documents indicate that submittals shall be transmitted simultaneously to Architect and Owner, allow 15 days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.
- C. Paper Submittals: Place a permanent label or title block on each submittal item for identification.
  1. Indicate name of firm or entity that prepared each submittal on label or title block.
  2. Provide a space approximately 6 by 8 inches (150 by 200 mm) on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
  3. Include the following information for processing and recording action taken:

- a. Project name.
  - b. Date.
  - c. Name of Architect.
  - d. Name of Contractor.
  - e. Name of subcontractor.
  - f. Name of supplier.
  - g. Name of manufacturer.
  - h. Submittal number or other unique identifier, including revision identifier.
    - 1) Submittal numbers shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).
  - i. Number and title of appropriate Specification Section.
  - j. Drawing number and detail references, as appropriate.
  - k. Location(s) where product is to be installed, as appropriate.
  - l. Other necessary identification.
4. Additional Paper Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
5. Transmittal for Paper Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return without review submittals received from sources other than Contractor.
- a. Transmittal Form for Paper Submittals: Provide locations on form for the following information:
    - 1) Project name.
    - 2) Date.
    - 3) Destination (To:).
    - 4) Source (From:).
    - 5) Name and address of Architect.
    - 6) Name of Contractor.
    - 7) Name of firm or entity that prepared submittal.
    - 8) Names of subcontractor, manufacturer, and supplier.
    - 9) Category and type of submittal.
    - 10) Submittal purpose and description.
    - 11) Specification Section number and title.
    - 12) Specification paragraph number or drawing designation and generic name for each of multiple items.
    - 13) Drawing number and detail references, as appropriate.
    - 14) Indication of full or partial submittal.
    - 15) Transmittal number: numbered consecutively.
    - 16) Submittal and transmittal distribution record.
    - 17) Remarks.
    - 18) Signature of transmitter.
- D. Options: Identify options requiring selection by Architect.

- E. Resubmittals: Make resubmittals in same form and number of copies 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.
- F. 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.
- G. 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: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
  - 1. Action Submittals: Submit 4 paper copies of each submittal unless otherwise indicated. Architect will return 2 copies.
  - 2. Informational Submittals: Submit 4 paper copies of each submittal unless otherwise indicated. Architect will not return copies.
  - 3. 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 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. 4 paper copies of Product Data unless otherwise indicated. Architect will return 2 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 unless submittal based on Architect's digital data drawing files is otherwise permitted.
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 on sheets at least 8-1/2 by 11 inches (215 by 280 mm), but no larger than 30 by 42 inches (750 by 1067 mm).
3. Submit Shop Drawings in the following format:
- a. 4 opaque (bond) copies of each submittal. Architect will return 2 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.

- e. Specification paragraph number and generic name of each item.
3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance 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.
  4. 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 2 full sets of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return 1 set with options selected.
  5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. 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 2 sets of Samples. Architect will retain 1 Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record sample.
      - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
      - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least 2 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. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
  2. Manufacturer and product name, and model number if applicable.
  3. Number and name of room or space.
  4. Location within room or space.
  5. Submit product schedule in the following format:
    - a. PDF electronic file.

- b. 3 paper copies of product schedule or list unless otherwise indicated. Architect will return 2 copies.
- F. Coordination Drawing Submittals: Comply with requirements specified in Division 01 Section "Project Management and Coordination."
- G. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
- H. Application for Payment and Schedule of Values: Comply with requirements specified in Division 01 Section "Payment Procedures."
- I. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Division 01 Section "Quality Requirements."
- J. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Division 01 Section "Closeout Procedures."
- K. Maintenance Data: Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."

### 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.
- B. Project Closeout and Maintenance Material Submittals: See requirements in Division 01 Section "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.
  - 1. Submittals lacking contractor's approval stamp will be returned without action.

#### 3.2 ARCHITECT'S ACTION

- A. Action Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.
- B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

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- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- 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 be returned by the Architect without action.

END OF SECTION 013300



## SECTION 013400 – SITE WORK SUBMITTALS

### PART 1 - GENERAL

#### 1.1 SCOPE OF WORK

##### A. Definitions:

1. Samples: Physical examples prepared to illustrate materials, equipment or workmanship and to establish standards by which work will be judged as complying with contract requirements.
2. Shop drawings: Drawings, diagrams, illustrations, schedules and performance charts, prepared to illustrate a portion of work in detail.
3. Product data: Dated, printed literature of a product manufacturer which describes product and installation procedures.
4. Submittals: General term including samples, shop drawings and product data, as applicable.

##### B. General provisions:

Reference the individual specification sections for a list of required submittals.

1. Provisions in this section are mandatory procedures for preparing and submitting samples, shop drawings and product data.
2. Submissions shall be in orderly sequence and timed to cause no delay in the Work.
3. Job delays occasioned by requirement of submission of samples, shop drawings and product data not in accord with Contractor Documents are Contractor's responsibility, and will not be considered valid justification for extension of Contract Time.
4. Commence no portion of work requiring submittals until submittal has been acted upon by the Owner's Representative.

#### 1.2 PRODUCT DATA PREPARATION

- A. Include product manufacturer's dated, printed material with product description and installation instructions indicated. Data not related to project shall be deleted.
- B. Form: Number of copies submitted shall be the number required by Contractor plus one which will be retained by the Engineer and one copy which shall be included in the Owner's Representative's file.

#### 1.3 CONTRACTOR'S REVIEW

- A. Review all submittals before forwarding to the Engineer and stamp to indicate conformance with requirements hereinafter specified.
- B. Determine and verify field measurements, construction, materials, catalog numbers and similar data. Coordinate each submittal with requirements of work and Contract Documents.
- C. Where work is indicated "By Others", Contractor shall indicate subcontractor responsible for providing and coordinating such work.
- D. Contractor agrees that submittals processed by the Engineer are not Change Orders, that the purpose of submittals by the Contractor is to demonstrate that the Contractor understands the design concept, that he demonstrates his understanding by indicating materials he intends to furnish and install and by detailing fabrication and installation methods he intends to use.

- E. Contractor represents by submitting samples, shop drawings and product data that he has complied with provisions specified above. Submissions made without Contractor's approval indicated thereon will be returned without being reviewed for compliance with this requirement.
- F. Date each submittal and indicate the name of Project, Engineer, Contractor and Subcontractor, as applicable, description or name of equipment, material or product, and location at which material or product is to be used.
- G. Accompany submittal with transmittal letter containing Project name, Contractor's name, number of submittals titles and other pertinent data. Transmittal shall outline deviations, if any, in submittals from requirements of Contract Documents.

#### 1.4 ENGINEER'S REVIEW

- A. Engineer will review submittals with reasonable promptness.
- B. Engineer's review is only to determine conformance with design concept of project and with information in Contract Documents. Engineer's determination regarding an individual item shall not extend to the entire assembly in which the item functions.
- C. Engineer's review of submittals shall not relieve Contractor of responsibility for any deviation from requirements of Contract Documents unless Contractor has informed the Engineer in writing of such deviation at time of submission and the Engineer has given written acknowledgment of the specific deviation. Engineer's review shall in no way relieve Contractor from responsibility for errors or omissions in submittals.
- D. Engineer will return submittals to Contractor marked with appropriate comment.

#### 1.5 RESUBMISSION

- A. Make corrections and changes indicated for unacceptable submissions and resubmit in same manner as specified above.
- B. In resubmission transmittal direct specific attention to revisions other than corrections requested by Engineer on previous submissions, if any.

#### 1.6 DISTRIBUTION

- A. Contractor is responsible for obtaining and distributing copies of submittals to his Subcontractors and material suppliers after as well as before final approval. Prints of reviewed shop drawings shall be made from transparencies which carry the Engineer's appropriate stamp.
- B. Contractor shall maintain a file of processed submittals for the duration of the project, including a complete set in the project field office.

**End of Section 013400**

## SECTION 014000 - QUALITY REQUIREMENTS

### 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 administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
  - 1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
  - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
  - 3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
- C. Related Requirements:
  - 1. Divisions 02 through 33 Sections for specific test and inspection requirements.

#### 1.3 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.
- C. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.

- D. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- E. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.
- F. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- H. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
  - 1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- I. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of 5 previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

#### 1.4 CONFLICTING REQUIREMENTS

- A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:
  - 1. Seismic-force-resisting system, designated seismic system, or component listed in the designated seismic system quality-assurance plan prepared by Architect.

2. Main wind-force-resisting system or a wind-resisting component listed in the wind-force-resisting system quality-assurance plan prepared by Architect.

## 1.6 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, and telephone number of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

- D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

## 1.7 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional 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.
- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
  - 1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- G. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- H. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

## 1.8 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
  2. Payment for these services will be made by Owner directly.
  3. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.
1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
  2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
    - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
  3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
  4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
  5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
  6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 01 Section "Submittal Procedures."
- D. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- E. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- F. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.

2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of Contractor.

G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

## 1.9 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner as indicated in Statement of Special Inspections included in Section 000308-“Information Available to Bidders”.

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 ACCEPTABLE TESTING AGENCIES

A. ECS Limited- (843) 706- 7007



3.2 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
  - 1. Date test or inspection was conducted.
  - 2. Description of the Work tested or inspected.
  - 3. Date test or inspection results were transmitted to Architect.
  - 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.3 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
  - 1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Division 01 Section "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

## SECTION 015723 - STORM WATER POLLUTION PREVENTION MEASURES

### PART 1 - GENERAL

#### 1.1 SCOPE OF WORK

- A. The contractor shall provide all labor, equipment and materials necessary to construct and maintain all storm water pollution prevention measures as specified on the Drawings and by all applicable local and state requirements. The contractor shall supplement these with additional measures as required by on site conditions during all phases of construction.
- B. The contractor shall provide all storm water pollution prevention measures indicated on the Drawings and shall reinstall and/or relocate measures as necessary to continue construction without allowing storm water pollution accumulation downstream.
- C. Storm Water Pollution Prevention Measures used shall be those specified on the plans and supplemented by those recommended by guidelines prepared and issued by governing jurisdictions.
- D. The contractor shall provide all labor, equipment and materials necessary to comply with the requirements of the local adaptations of the National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated with Construction Activity and the site specific Best Management Practices Plan provided by the Engineer including, but not limited to, site inspections and storm water sampling and testing. The contractor shall also provide a copy of all test and inspection reports to the Engineer and the Owner's Representative within 2 days of the event in question.

#### 1.2 REFERENCE DOCUMENTS

- A. Texas Department of Transportation Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges, 2004
- B. All applicable local and state Manuals, Guidelines, and Specifications pertaining to the Installation, Implementation, and Maintenance of Storm Water Pollution Prevention Measures.
- C. Local and State Standards and Specifications, including but not limited to, the Texas Department of Environmental Protection for NPDES permitting and City of Westworth Village, Texas for stormwater management applications and erosion and sediment control practices.

#### 1.3 SUBMITTALS

Comply with the applicable provisions of Section 013400 Site Work Submittals.

- A. Submit the brand name(s) and the name(s) of all material suppliers along with a sample of the material(s) to be used, for each Best Management Practice indicated herein and on the civil drawings.
- B. Provide materials from the same source throughout the Work. A change of source requires the Owner's Representatives' approval.

#### 1.4 EROSION AND SEDIMENT CONTROLS

##### A. Stabilization Practices

- 1. The stabilization practices to be implemented shall include, but not be limited to the

- temporary and permanent measures as shown on the Drawings.
2. The Contractor shall record the dates when major grading activities occur (e.g. clearing, grubbing, excavation, embankment, and grading) in his daily log.
  3. Portions of the site where construction activities have temporarily or permanently ceased for fourteen days shall be stabilized with a temporary measure as shown on the Drawings.
  4. Portions of the site where construction activities have temporarily or permanently ceased for twenty-one days shall be stabilized with a permanent measure as shown on the Drawings.
  5. Where the initiation of vegetative measures by the fourteenth day after construction activity temporarily or permanently ceases is precluded by unsuitable conditions caused by the weather, vegetative practices shall be initiated as soon as practicable after conditions become suitable.

B. Structural Practices

Structural practices shall be implemented to divert flows from exposed soils, temporarily store flows, or otherwise limit runoff and the discharge of pollutants from exposed areas of the site. Structural practices shall be implemented in a timely manner during the construction process to minimize erosion and sediment runoff. Structural practices shall include, but shall not be limited to the temporary and permanent measures shown on the Drawings. All structural practices are to be installed where shown on the Drawings or as instructed by the Inspector or the Engineer. The details of installation and construction are as shown on the Drawings and shall be in accordance with all applicable local and State standards.

1.5 PROJECT CONDITIONS

- A. Environmental Requirements: Protect adjacent properties and water resources from pollution and erosion and sediment damage throughout Work.

**PART 2 - PRODUCTS**

2.1 COMPONENTS FOR BEST MANAGEMENT PRACTICES

- A. All Best Management Practices used for the project shall comply with the requirements indicated on the Drawings
- B. All Best Management Practices used for the project shall comply with the requirements of all State and local applicable codes. Where a conflict between the State or local requirements and the Drawings exists, the more conservative option shall govern.

**PART 3 - EXECUTION**

3.1 INSTALLATION OF BEST MANAGEMENT PRACTICES

- A. All Best Management Practices used for the project shall be installed according to the requirements indicated on the Drawings
- B. All Best Management Practices used for the project shall be installed according to the requirements of all State and local applicable codes. Where a conflict between the State or local requirements and the Drawings exists, the more conservative option shall govern.

3.2 MAINTENANCE OF BEST MANAGEMENT PRACTICES

- A. All Best Management Practices used for the project shall be maintained as directed by the requirements indicated on the Drawings

- B. All Best Management Practices used for the project shall be maintained as directed by the requirements of all State and local applicable codes. Where a conflict between the State or local requirements and the Drawings exists, the more conservative option shall govern.

### 3.3 INSPECTIONS

- A. The contractor shall inspect all Best management Practices as noted on the Drawings or as required by State and local codes. Where a conflict between the State or local requirements and the Drawings exists, the more conservative option shall govern. The mandated inspections shall be treated as a minimum standard.
- B. All inspections shall adhere to the protocols specified on the Drawings or by the State and local codes. Where a conflict between the State or local requirements and the Drawings exists, the more conservative option shall govern.
- C. For each inspection conducted, the Contractor shall prepare a report providing all information as required on the Drawings or by State and local codes. Where a conflict between the State or local requirements and the Drawings exists, the more conservative option shall govern.

**End of Section 015723**

SECTION 01600 PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General product requirements.
- B. Transportation, handling, storage and protection.
- C. Product option requirements.
- D. Substitution limitations and procedures.
- E. Procedures for Owner-supplied products.
- F. Spare parts and maintenance materials.

1.02 RELATED SECTIONS

- A. Section 01400 - Quality Requirements: Product quality monitoring.

1.03 SUBMITTALS

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

PART 2 PRODUCTS

2.01 NEW PRODUCTS

- A. Provide new products unless specifically required or permitted by the Contract Documents.
- B. Do not use products having any of the following characteristics:
- C. Where all other criteria are met, Contractor shall give preference to products that:
  - 1. Are extracted, harvested, and/or manufactured closer to the location of the project.
  - 2. Have longer documented life span under normal use.
  - 3. Result in less construction waste.

2.02 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

## 2.03 SPARE PARTS AND MAINTENANCE PRODUCTS

- A. Provide spare parts, maintenance, and extra products of types and in quantities specified in individual specification sections.
- B. Deliver to Project site; obtain receipt prior to final payment.

## PART 3 EXECUTION

### 3.01 SUBSTITUTION PROCEDURES

- A. General: Whenever a material, article, or piece of equipment is identified on the drawings or in the specifications by reference to manufacturer's or vendor's names, trade names or catalog numbers it is intended to establish a standard of quality for products. Other materials, articles, or equipment of other manufacturers which will adequately perform the duties imposed by the general design will be considered equally acceptable provided the material, article or equipment so proposed, is, in the opinion of the Owner, of equal substance and function. The Contractor is required to provide all documentation and research required for qualifying substitute materials as being equal or superior to the products specified. All equals shall be submitted to the Architect five (5) working days prior to the bid deadline and no equal shall be purchased or installed by the Contractor without the Architect's written approval.
- B. Instructions to Bidders specify time restrictions for submitting requests for substitutions during the bidding period. Comply with requirements specified in this section.
- C. Architect will consider requests for substitutions only during the Bidding Phase. Substitutions will not be considered after the Bidding Phase.
- D. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.
- E. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents.
- F. A request for substitution constitutes a representation that the submitter:
  - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
  - 2. Will provide the same warranty for the substitution as for the specified product.
  - 3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
  - 4. Waives claims for additional costs or time extension which may subsequently become apparent.
- G. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.
- H. Substitution Submittal Procedure:
  - 1. Use Architect provided Substitution Request Form.
  - 2. Submit three copies of request for substitution for consideration. Limit each request to one proposed substitution.
  - 3. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence. Burden of proof is on proposer.
  - 4. The Architect will notify Contractor in writing of decision to accept or reject request.

### 3.02 OWNER-SUPPLIED PRODUCTS

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

### 3.03 TRANSPORTATION AND HANDLING

- A. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- B. Transport and handle products in accordance with manufacturer's instructions.
- C. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
- D. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- E. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.
- F. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

### 3.04 STORAGE AND PROTECTION

- A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.
- B. Store and protect products in accordance with manufacturers' instructions.
- C. Store with seals and labels intact and legible.
- D. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
- E. For exterior storage of fabricated products, place on sloped supports above ground.
- F. Provide bonded off-site storage and protection when site does not permit on-site storage or protection.
- G. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- H. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- I. Prevent contact with material that may cause corrosion, discoloration, or staining.

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- J. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- K. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION 016000



SECTION 017300 - EXECUTION

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 general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Coordination of Owner-installed products.
5. Progress cleaning.
6. Starting and adjusting.
7. Protection of installed construction.
8. Correction of the Work.

- B. Related Requirements:

1. Division 01 Section "Summary" for limits on use of Project site.
2. Division 01 Section "Submittal Procedures" for submitting surveys.
3. Division 01 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For land surveyor.
- B. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.
- C. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal if applicable.
- D. Certified Surveys: Submit 2 copies signed by land surveyor.
- E. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

#### 1.4 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

#### PART 2 - PRODUCTS (Not Used)

#### PART 3 - EXECUTION

##### 3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.
  - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
  - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
  - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
  - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
  - 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
  - 1. Description of the Work.
  - 2. List of detrimental conditions, including substrates.
  - 3. List of unacceptable installation tolerances.
  - 4. Recommended corrections.
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Division 01 Section "Project Management and Coordination."

### 3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.
  - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
  - 2. Establish limits on use of Project site.
  - 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
  - 4. Inform installers of lines and levels to which they must comply.
  - 5. Check the location, level and plumb, of every major element as the Work progresses.
  - 6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
  - 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

### 3.4 FIELD ENGINEERING

- A. Reference Points: Locate existing permanent benchmarks, control points, property corners and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
  - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
  - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- B. Benchmarks: Establish and maintain a minimum of 2 permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
  - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
  - 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
  - 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- C. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.
- D. Final Property Survey: Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
  - 1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
  - 2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

### 3.5 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
  2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
  3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
  4. Maintain minimum headroom clearance of 96 inches (2440 mm) in occupied spaces and 90 inches (2300 mm) in unoccupied spaces.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
  2. Allow for building movement, including thermal expansion and contraction.
  3. Coordinate installation of anchorages. 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.
- I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

### 3.6 OWNER-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for Owner's construction personnel.

- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.
  - 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.

### 3.7 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
  - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
  - 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).
  - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
    - a. Use containers intended for holding waste materials of type to be stored.
  - 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
  - 1. Remove liquid spills promptly.
  - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways.
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

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- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

### 3.8 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: Comply with qualification requirements in Division 01 Section "Quality Requirements."

### 3.9 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

## **SECTION 017419 - CLEANING UP**

### **PART 1 - GENERAL**

#### **1.1 GENERAL REQUIREMENTS**

- A. Contractor shall keep the project site free from accumulation of waste materials and rubbish at all times during the construction period. At completion of the Work, he shall remove all waste materials and rubbish from and about the project, as well as his tools, construction equipment, machinery and surplus materials, except those specifically required by the Contract Documents to be left for maintenance by Navy Federal Credit Union.
- B. If Contractor fails to keep project clean or to clean up prior to Date of Substantial Completion, the Owner's Representative may do so and the cost will be charged to the Contractor.

#### **1.2 SAFETY REQUIREMENTS**

- A. Store volatile waste in covered metal containers. Remove from project site daily.
  - 1. Allow no volatile wastes to accumulate on project site.
  - 2. Provide adequate ventilation during use of volatile substances.
- B. Do not burn or bury waste materials or rubbish on project site.
- C. Dispose of no volatile wastes such as mineral spirits, oil or paint thinner in storm or sanitary drains, on pavements, in gutters or on project site.
- D. Dispose of no waste or cleaning materials containing materials harmful to plant growth on project site and clean up materials which are accidentally spilled, as quickly as possible.

#### **1.3 CLEAN-UP DURING CONSTRUCTION**

- A. Execute cleaning procedures to ensure that building, project site and adjacent properties are maintained free from debris and rubbish.
- B. Wet down materials subject to blowing. Throw no waste materials from heights.
- C. Provide covered on-site containers for waste collection. Place all waste materials and rubbish in containers in an expeditious manner to prevent accumulation. Remove waste from project site when containers become full.
- D. Legally dispose of all waste materials, rubbish, volatile materials and cleaning materials off project site.
- E. Dispose of no materials in waterways.
- F. Allow no accumulation of debris contributing to survival or spread of rodents, roaches or other pests.
  - 1. On a daily basis, remove debris containing food scraps.
  - 2. Contractor shall be responsible for securing services of a pest exterminator at no additional cost to the Owner.

**End of Section 017419**



## SECTION 017700 - CLOSEOUT PROCEDURES

### 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 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.
- B. Related Requirements:
  - 1. Division 01 Section "Execution" for progress cleaning of Project site.
  - 2. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
  - 3. Division 01 Section "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
  - 4. Divisions 02 through 33 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

#### 1.3 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.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.
- C. Field Report: For pest control inspection.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.6 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 Divisions 02 through 33 Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
  - 4. Submit maintenance material submittals specified in individual Divisions 02 through 33 Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. 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 Architect's signature for receipt of submittals.
  - 5. Submit test/adjust/balance records.
  - 6. Submit sustainable design submittals required in Division 01 sustainable design requirements Section and in individual Division 02 through 33 Sections.
  - 7. 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 specified in Division 01 Section "Demonstration and Training."
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 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.

#### 1.7 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:

1. Submit a final Application for Payment according to Division 01 Section "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.

B. Inspection: Submit a written request for final inspection to determine acceptance 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 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.

## 1.8 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.
1. Organize list of spaces in sequential order, starting with exterior areas first.
  2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
  3. Include the following information at the top of each page:
    - a. Project name.
    - b. Date.
    - c. Name of Architect.
    - d. Name of Contractor.
    - e. Page number.
  4. Submit list of incomplete items in the following format:
    - a. MS Excel electronic file. Architect will return annotated file.
    - b. PDF electronic file. Architect will return annotated file.
    - c. 3 paper copies. Architect will return 2 copies.

## 1.9 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. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of 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 (215-by-280-mm) 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.
- D. 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. 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 ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
    - 1) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report on completion of cleaning.
  - p. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
  - q. Leave Project clean and ready for occupancy.
- C. Pest Control: Comply with pest control requirements in Division 01 Section "Temporary Facilities and Controls." Prepare written report.

### 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

## SECTION 017823 - OPERATION AND MAINTENANCE DATA

### 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 administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory.
2. Emergency manuals.
3. Operation manuals for systems, subsystems, and equipment.
4. Product maintenance manuals.
5. Systems and equipment maintenance manuals.

- B. Related Requirements:

1. Division 01 Section " Multiple Contract Summary" for coordinating operation and maintenance manuals covering the Work of multiple contracts.
2. Division 01 Section " Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
3. Division 01 Section "General Commissioning Requirements" for verification and compilation of data into operation and maintenance manuals.
4. Divisions 02 through 33 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

#### 1.3 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Architect will comment on whether content of operations and maintenance submittals are acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

- B. Format: Submit operations and maintenance manuals in the following format:
1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.
    - a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
    - b. Enable inserted reviewer comments on draft submittals.
  2. Three paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Architect will return two copies.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.
1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.

## PART 2 - PRODUCTS

### 2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

- A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:
1. List of documents.
  2. List of systems.
  3. List of equipment.
  4. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to



ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

## 2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
1. Title page.
  2. Table of contents.
  3. Manual contents.
- B. Title Page: Include the following information:
1. Subject matter included in manual.
  2. Name and address of Project.
  3. Name and address of Owner.
  4. Date of submittal.
  5. Name and contact information for Contractor.
  6. Name and contact information for Construction Manager.
  7. Name and contact information for Architect.
  8. Name and contact information for Commissioning Authority.
  9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
  10. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
  2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily

navigated file tree. Configure electronic manual to display bookmark panel on opening file.

- F. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.
1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (215-by-280-mm) paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
    - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
    - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
  2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
  3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
  4. Supplementary Text: Prepared on 8-1/2-by-11-inch (215-by-280-mm) white bond paper.
  5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
    - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
    - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

## 2.3 EMERGENCY MANUALS

- A. Content: Organize manual into a separate section for each of the following:
1. Type of emergency.
  2. Emergency instructions.
  3. Emergency procedures.
- B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
1. Fire.
  2. Flood.
  3. Gas leak.
  4. Water leak.
  5. Power failure.
  6. Water outage.

7. System, subsystem, or equipment failure.
  8. Chemical release or spill.
- C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- D. Emergency Procedures: Include the following, as applicable:
1. Instructions on stopping.
  2. Shutdown instructions for each type of emergency.
  3. Operating instructions for conditions outside normal operating limits.
  4. Required sequences for electric or electronic systems.
  5. Special operating instructions and procedures.

## 2.4 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
  2. Performance and design criteria if Contractor has delegated design responsibility.
  3. Operating standards.
  4. Operating procedures.
  5. Operating logs.
  6. Wiring diagrams.
  7. Control diagrams.
  8. Piped system diagrams.
  9. Precautions against improper use.
  10. License requirements including inspection and renewal dates.
- B. Descriptions: Include the following:
1. Product name and model number. Use designations for products indicated on Contract Documents.
  2. Manufacturer's name.
  3. Equipment identification with serial number of each component.
  4. Equipment function.
  5. Operating characteristics.
  6. Limiting conditions.
  7. Performance curves.
  8. Engineering data and tests.
  9. Complete nomenclature and number of replacement parts.
- C. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
  2. Equipment or system break-in procedures.
  3. Routine and normal operating instructions.
  4. Regulation and control procedures.

5. Instructions on stopping.
  6. Normal shutdown instructions.
  7. Seasonal and weekend operating instructions.
  8. Required sequences for electric or electronic systems.
  9. Special operating instructions and procedures.
- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

## 2.5 PRODUCT MAINTENANCE MANUALS

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Product Information: Include the following, as applicable:
1. Product name and model number.
  2. Manufacturer's name.
  3. Color, pattern, and texture.
  4. Material and chemical composition.
  5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
1. Inspection procedures.
  2. Types of cleaning agents to be used and methods of cleaning.
  3. List of cleaning agents and methods of cleaning detrimental to product.
  4. Schedule for routine cleaning and maintenance.
  5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

## 2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
  - 1. Standard maintenance instructions and bulletins.
  - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
  - 3. Identification and nomenclature of parts and components.
  - 4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
  - 1. Test and inspection instructions.
  - 2. Troubleshooting guide.
  - 3. Precautions against improper maintenance.
  - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  - 5. Aligning, adjusting, and checking instructions.
  - 6. Demonstration and training video recording, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
  - 1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
  - 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

### PART 3 - EXECUTION

#### 3.1 MANUAL PREPARATION

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.
- B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
  1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
  2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
  1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
  1. Do not use original project record documents as part of operation and maintenance manuals.
  2. Comply with requirements of newly prepared record Drawings in Division 01 Section "Project Record Documents."
- G. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

## SECTION 024100 - DEMOLITION

### PART 1 - GENERAL

#### 1.1 SCOPE OF WORK

- A. The Contractor shall provide all labor, materials, equipment, and incidentals necessary for the following:
  - 1. Demolition and removal of entire buildings, structures, and foundations;
  - 2. Demolition and removal of site elements;
  - 3. Required demolition as indicated on the drawings.
- B. The Contractor shall provide barricades, warning signs, and warning lights around open excavations as necessary to prevent injury to persons.
- C. The Contractor is solely responsible for determining the potential for injury to persons and damage to property. Where such potential is present, the contractor shall take appropriate measures to protect persons from injury and protect existing and new improvements from damage caused directly or indirectly by construction operations.

#### 1.2 SUBMITTALS

Comply with the applicable provisions of Section 01 33 00 Site Work Submittals.

- A. Proposed Demolition Activities:
  - 1. Submit proposed schedule of demolition activities. Indicate starting and ending dates for each activity as appropriate. Indicate starting and ending dates for all interruptions and restoration of utility services.
  - 2. Submittal of proposed demolition activities will be reviewed by the Owner only to determine that proposed activities will not interfere with the Owner's operations.
- B. Photographs: Before starting work, file photographs with the Owner that document existing conditions on the site and adjacent to the site that could be mistaken later for damage caused by demolition operations.
- C. Project Record Documents:
  - 1. Identify location of capped utilities.
  - 2. Indicate unanticipated structural, electrical, or mechanical conditions.

#### 1.3 PROJECT CONDITIONS

- A. Existing Conditions:
  - 1. After the project is begun, the Contractor is responsible for the condition of structures to be demolished. NFCU does not warrant that the condition of structures to be demolished will not have changed since the time of inspection for bidding purposes.
  - 2. NFCU reserves the right to remove and salvage portions of the structure prior to the start of demolition.

- B. Unforeseen Conditions: Should unforeseen conditions be encountered that affect design or function of project, investigate fully and submit an accurate, detailed, written report to the Owner. While awaiting the Owner's response, reschedule operations if necessary to avoid delay of overall project.

#### 1.4 SEQUENCING AND SCHEDULING

- A. Arrange demolition schedule so as not to interfere with NFCU's operations.

#### 1.5 UTILITY PROTECTION

- A. Forty-eight (48) hours prior to excavation, the Contractor shall call the appropriate Utilities Protection Entity to locate and protect existing utilities. Any damage to these utilities is to be repaired at no additional cost to NFCU. The Contractor is responsible for locating all utilities, either private or public prior to beginning demolition work.

### **PART 2 - PRODUCTS**

Not Applicable

### **PART 3 - EXECUTION**

#### 3.1 EXAMINATION

- A. Verify that utilities have been disconnected and sealed.
- B. Survey existing conditions and correlate with the contract drawings and specifications to determine extent of demolition required.
- C. Insofar as is practicable, arrange operations to reveal unknown or concealed structural conditions for examination and verification before removal or demolition.
- D. Verify actual conditions to determine in advance whether removal or demolition of any element will result in structural deficiency, overloading, failure, or unplanned collapse.
- E. Perform continuing surveys as the work progresses to detect hazards resulting from demolition or construction activities.

#### 3.2 PREPARATION

- A. Hazardous Materials: Remove, drain, purge, or otherwise dispose of hazardous materials present before proceeding with demolition operations. Comply with applicable regulations concerning disposal.
- B. Traffic: Do not obstruct walks or public ways without the written permission of governing authorities and of the Owner. Where routes are permitted to be closed, provide alternate routes if required.
- C. Protection:
  - 1. Provide for the protection of persons passing around or through the area of demolition.
  - 2. Perform demolition so as to prevent damage to adjacent improvements and facilities to remain.
  - 3. Provide protective measures to ensure free and safe passage of persons to and from occupied areas.



4. Erect temporary protection such as walks, fences, railings, canopies, etc., where required by authorities having jurisdiction.
  5. Protect walls, floors, and other new or existing work from damage during demolition operations.
  6. Protect existing site appurtenances and landscaping to remain.
  7. Erect a plainly visible fence at least 5 feet from trunks of individual trees or around outer perimeter of clumps of trees.
- D. Damages: Without cost to NFCU and without delay, repair any damages caused to facilities to remain.

### 3.3 UTILITY SERVICES

- A. Arrange with utility companies and shut off all utilities serving structures as necessary.
- B. Disconnect and cap indicated utilities before starting demolition operations.
- C. Identify location of capped utilities on project record documents.
- D. Obtain written approval before interrupting existing utilities.
- E. Bypass Connections: Provide as necessary to maintain service to occupied areas.
- F. Notify NFCU at least 72 hours in advance of changeover.

### 3.4 EXPLOSIVES

- A. Do not use explosives.

### 3.5 POLLUTION CONTROLS

- A. Control as much as practicable the spread of dust and dirt.
- B. Observe environmental protection regulations.
- C. Do not allow water usage resulting in freezing or flooding.
- D. Do not allow adjacent improvements to remain to become soiled by demolition operations.

### 3.6 DEMOLITION - GENERAL

- A. Remove: Unless items are otherwise indicated to be reinstalled or salvaged, remove and scrap.
- B. Remove and Re-Install: Remove items indicated; clean, service, and otherwise prepare for service; reinstall in the same location (or in the location indicated).
- C. Remove and Install New: Remove and dispose of items indicated and install new items in the same location (or in the location indicated).
- D. Remove and Salvage: Items indicated to be salvaged will remain NFCU's property. Carefully remove and clean items indicated to be salvaged; pack or crate to protect against damage; identify contents of containers; deliver to the locations indicated.
- E. Remove and Scrap: Remove and dispose of items indicated.

1. All demolished or removed items and materials shall be considered scrap except for those indicated to remain, those indicated to be reinstalled, those indicated to be salvaged, and historical items.
  2. No removed items which the contractor deems valuable shall be stored on site.
- F. Existing to Remain: Construction or items indicated to remain shall be protected against damage during demolition operations. Where practicable, and with NFCU's permission, the Contractor may elect to remove items to a suitable storage location during demolition and then properly clean and reinstall the items.
- G. Historical items, relics, and similar items (including but not limited to cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to NFCU) which may be encountered in the course of demolition will remain NFCU's property. Notify NFCU if such items are encountered. Obtain NFCU's and the Engineer's acceptance of removal methods, and salvage these items to the NFCU.
- H. Detailed requirements for cutting are specified under Cutting and Patching in Division 1.
- I. Perform work in a systematic manner.
- J. Demolish and remove existing construction only to the extent required by new construction and as indicated in the contract documents.
- K. Remove debris daily.
- L. Use any methods permitted by governing regulations and the requirements of the Contract Documents.

### 3.7 DEMOLITION ON OR BELOW GRADE

- A. Where portions of concrete slabs-on-grade are to be removed, first outline the portion with a concrete saw to a depth of at least 1-inch.
- B. Remove concrete slabs-on-grade.
- C. Completely remove below-grade construction, including foundations, footings and utility lines to be abandoned, except as noted otherwise on the drawings.

### 3.8 FILLING BELOW-GRADE AREAS AND VOIDS

- A. Below-grade areas and voids resulting from demolition of structures shall be filled or excavated further, as appropriate, according to requirements specified elsewhere in Division 2 and in accordance with the Geotechnical Engineer's recommendations.

### 3.9 DISPOSAL OF DEMOLISHED MATERIALS

- A. Promptly dispose of materials resulting from demolition operations. Do not allow materials to accumulate on site.
- B. Transport materials resulting from demolition operations and legally dispose of off-site.
- C. Off-site disposal location shall not be within one-half mile of any portion of the project site or within sight of the project site.

- D. Do not burn removed materials on project site.
- E. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.

3.10 CLEANING

- A. Remove tools and equipment. Dispose of scrap.
- B. Leave exterior areas free of debris.
- C. Clean soils, smudges, and dust from surfaces to remain.
- D. Return structures and surfaces to remain to the condition that existed prior to commencement of demolition.

**End of Section 024100**

SECTION 03 1000 - CONCRETE FORMWORK

PART 1 - GENERAL

1.01 SUMMARY

- A. Related Documents: General and Supplementary Conditions of the Contract, Division 1 - General Requirements, and Drawings are applicable to this Section.
- B. Section Includes:
  - 1. Formwork for cast-in-place concrete, with shoring, bracing, and anchorage.
  - 2. Openings for other affected work.
  - 3. Form accessories.
  - 4. Stripping forms.

1.02 WORK INSTALLED BUT FURNISHED UNDER OTHER SECTIONS

- A. Section 04300 - Unit Masonry: Masonry accessories attached to formwork.
- B. Section 05500 - Metal Fabrications: Metal fabrications attached to formwork.
- C. Section 07620 - Sheet Metal Flashing and Trim: Flashing reglets attached to formwork.
- D. Division 15 - Mechanical Items and sleeves attached to formwork.
- E. Division 16 - Electrical Items and sleeves attached to formwork.

1.03 SYSTEM DESCRIPTION

- A. Design, engineer, and construct formwork, shoring, and bracing to meet design and code requirements, so that resultant concrete conforms to required shapes, lines, and dimensions.

1.04 QUALITY ASSURANCE

- A. Construct and erect concrete formwork in accordance with ACI 301 and 347.

1.05 REGULATORY REQUIREMENTS

- A. Conform to applicable building code.

1.06 SUBMITTALS

- A. Submit product data under provisions of Section 01300 for tape, gaskets, form inserts, sealer, release agent, ties, waterstops, construction joints, and joint fillers.
- B. Submit manufacturer's installation instruction for void form materials and waterstops under provisions of Section 01300.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials under provisions of Section 01600.
- B. Deliver materials in manufacturer's packaging with installation instructions.
- C. Store off ground in ventilated and protected area to prevent deterioration from moisture or damage.

1.08 COORDINATION

- A. Coordinate work under provisions of section 01300.
- B. Notify responsible trades of schedules of concrete pours so as to allow adequate time for installation and coordination of their work.
- C. Coordinate this Section with other Sections of work which require attachment of components to formwork.

- D. If formwork is placed after reinforcement resulting in insufficient concrete cover over reinforcement, request instructions from Architect/Engineer before proceeding.
- E. Verify plumbing, conduit, raceways, ducts, etc. are installed prior to concrete placement.

## PART 2 PRODUCTS

### 2.01 WOOD FORM MATERIALS

- A. Plywood: sheathing grade; sound, undamaged sheets with clean, true edges.
- B. Lumber: No. 2 or better grade; with grade stamp shall be clearly visible.

### 2.02 PREFABRICATED FORMS - MATERIALS

- A. Preformed Steel Forms: Minimum 16 gage matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
- B. Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces.

### 2.03 FORMWORK ACCESSORIES

- A. Form Ties: Snap-off metal of adjustable length; cone type; 1 inch break back dimension; free of defects that will leave holes no larger than 1-1/4 inches diameter in concrete surface.
- B. Form Release Agent: Colorless material which will not stain concrete, absorb moisture or affect bond of subsequent surface finish, or impair natural bonding or color characteristics of coating intended for use on concrete;
  - 1. Acceptable Manufacturers: Subject to compliance with requirements herein, provide products from one of the following:
    - a. Nox-Crete.
    - b. Symons.
- C. Fillets for Chamfered Corners and other justifications: Wood strips, sizes and configurations as detailed.
- D. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required; of strength and character to maintain formwork in place while placing concrete.
- E. Shores:
  - 1. Patented shores of approved design and manufacture, or built-up on job of stout timbers.
  - 2. Of adequate strength and properly braced to safely support imposed loads.
- F. Form Sealer
  - 1. Formfilm by W.R. Grace.
  - 2. Synthex by Industrial Synthetics Corporation.
  - 3. Pre-Form by Nox-Crete Co.
  - 4. Substitutions: Submit in accordance with Section 01600.
- G. Waterstop: 1 inch by 3/4 inch size, comprised of butyl rubber and bentonite clay.
  - 1. Acceptable Product: Volcay Waterstop-RX by American Colloid Co.
  - 2. Synco-Flex by Synco-Flex Products, Inc.
- H. Formed Construction Joints: Galvanized steel, tongue and groove type, knock-out holes spaced at 6 inches on center, with anchors.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify lines, levels, and measurements before proceeding with formwork.

### 3.02 EARTH FORMS

- A. Earth forms are not permitted.

### 3.03 ERECTION

- A. Minimize form joints. Symmetrically align joints and make watertight to prevent leakage of mortar.
- B. Arrange and assemble formwork to permit stripping, so that concrete is not damaged during its removal.
- C. Arrange forms to allow stripping without removal of principal shores, where required to remain in place.
- D. Provide bracing to ensure stability of formwork. Strengthen formwork liable to be overstressed by construction loads.
- E. Provide chamfer strips on external corners of beams, and columns where they will be exposed to view after completion of construction.
- F. Install void forms. Protect from moisture before concrete placement joists in accordance with manufacturers' requirements. Protect from crushing during concrete placement. Cap ends of void boxes as required. Replace damaged boxes before concrete placement.
- G. Provide a masonite top sheet over slabs on void cartons as a protective work surface.
- H. Do not displace or damage vapor barrier placed by Section 03300.
- I. Construct formwork to maintain tolerances in accordance with ACI 301.
- J. Construct form full depth of concrete to be placed.

### 3.04 APPLICATION OF FORM RELEASE AGENT

- A. Apply form release agent on formwork in accordance with manufacturer's instructions. Apply prior to placing reinforcing steel, anchoring devices, and embedded items.
- B. Do not apply form release agent where concrete surfaces are scheduled to receive special finishes or applied coverings which may be affected by agent. Soak contact surfaces of untreated forms with clean water. Keep surfaces wet prior to placing concrete.
- C. Do not apply form release agent where wood graining characteristics are required on finished concrete surfaces. Leave formwork dry.

### 3.05 INSERTS, EMBEDDED PARTS, AND OPENINGS

- A. Provide formed openings where required for work embedded in or passing through concrete.
- B. Locate and set in place items which will be cast directly into concrete.
- C. Coordinate work of other Sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts.
- D. Install accessories in accordance with manufacturer's instructions, level and plumb. Ensure items are not disturbed during concrete placement.
- E. Install waterstop in single lengths where possible. Install where detailed and wherever water penetration through construction joints is anticipated. Make provisions to support and protect water stops during progress of the work.
- F. Install construction joint device in coordination with floor slab pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.

### 3.06 FORMWORK TOLERANCES

- A. Construct formwork to maintain tolerances required by ACI 301.

3.07 FIELD QUALITY CONTROL

- A. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.
- B. Do not reuse wood formwork for concrete surfaces to be exposed to view. Do not patch formwork.
- C. Refer to Section 03300 for testing.

3.08 FORM REMOVAL

- A. Notify Architect prior to removing formwork.
- B. Do not remove forms, shoring and bracing until concrete has sufficient strength to support its own weight, and construction and design loads which may be imposed upon it.
- C. Do not damage concrete surfaces during form removal.
- D. When repair of surface defects or finishing is required at early age, remove forms as soon as concrete has hardened to resist damage from removal operation.
- E. Loosen wood forms for openings as soon as loosening can be accomplished without damage to concrete.
- F. Formwork for walls, sides of beams, and other parts not supporting weight of concrete may be removed as soon as concrete has hardened sufficiently to resist damage from removal operations.
- G. For exposed concrete surfaces, do not reuse formwork when it has deteriorated to the point where usage will affect the finished concrete appearance. Do not patch formwork.
- H. Do not place wood forms which cannot be retrieved after concrete placement. Use steel forms.

3.09 CLEANING

- A. Clean forms to remove foreign matter as erection proceeds.
- B. Ensure that water and debris drain to exterior through clean-out ports.
- C. During cold weather, remove ice and snow from forms. Do not use de-icing salts. Do not use water to clean out completed forms, unless formwork and construction proceed within heated enclosure. Use compressed air to remove foreign matter.

3.010 FORM RE-USAGE

- A. Thoroughly clean surfaces of forms and remove nails before reuse. Do not reuse damaged or worn forms. Inspect forms and retighten rustications as required.

END OF SECTION

SECTION 03 2000 - CONCRETE REINFORCEMENT

PART 1 GENERAL

1.01 SUMMARY

- A. Related Documents: General and Supplementary Conditions of the Contract, Division 1 - General Requirements, and Drawings are applicable to this Section.
- B. Section Includes:
  - 1. Reinforcing steel bars, and welded steel wire fabric for cast-in-place concrete.
  - 2. Support chairs, bolsters, and spacers, for supporting reinforcement.

1.02 QUALITY ASSURANCE

- A. Perform concrete reinforcement work in accordance with CRSI Manual of Standard Practice, Documents 63 and 65.
- B. Conform to ACI 301 and 315.

1.03 SUBMITTALS

- A. Submit shop drawings under provisions of Section 01 3000.
- B. Indicate sizes, spacings, locations and quantities of reinforcing steel, wire fabric, bending and cutting schedules, splicing, stirrup spacing, and supporting and spacing devices.

1.04 DELIVERY AND STORAGE

- A. Stack reinforcing steel in tiers and mark so that each length, size, shape and location can be readily determined. Exercise care to maintain reinforcement free of dirt, mud, paint or rust.
- B. Store materials and accessories on dunnage and under protective sheeting.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Reinforcing Steel: ASTM A 615, grade billet-steel deformed bars, uncoated, 60 KSI yield grade; ASTM A 706, grade 40 weldable for bars welded to steel members.
- B. Welded Steel Wire Fabric: ANSI/ASTM A 185 plain type; in flat sheets; uncoated finish.

2.02 ACCESSORY MATERIALS

- A. Tie Wire: Minimum 16 gage annealed type.
- B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during installation and placement of concrete including load bearing pad on bottom to prevent vapor barrier puncture.

2.03 FABRICATION

- A. Fabricate in accordance with ACI 315, providing concrete cover specified in Section 03300.
- B. Locate reinforcing splices not indicated on Drawings at points of minimum stress. Indicate location of splices on shop drawings.
- C. Weld reinforcing bars in accordance with ANSI/AWS D1.4.
- D. Provide sufficient lap of splicing of reinforcement, where required, to permit transfer of stress in accordance with requirements of this specification. Splice wall vertical reinforcement at location of horizontal construction joints.



- E. Unless otherwise noted on the drawings to be more, lap reinforcement 36 bar diameters (class "A" lap) at all splices or have dowels of same bar section and spacing as the bars to be spliced. Lap bars at least 36 diameters (class "A" lap) at corners and at abrupt changes in direction of walls. Stagger splices in adjacent bars.

### PART 3 EXECUTION

#### 3.01 PREPARATION

- A. Before placing concrete, clean reinforcement of foreign particles or coatings.

#### 3.02 PLACING

- A. Place reinforcement in accordance with CRSI "Placing Reinforcing Bars" and ACI 318, with provisions of ACI 318 governing.
- B. Move bars as necessary to avoid interference with other reinforcing steel, conduits, or embedded items.
- C. If bars are moved more than one bar diameter or enough to exceed tolerances, submit resulting arrangement of bars to Architect for review.
- D. Place, support, and secure reinforcement against displacement. Do not deviate from alignment or measurement. Place in accordance with approved shop drawings and CRSI recommendations. Do not heat, cut or bend bars without Architect's approval.
- E. All bars shall be tied in place prior to concreting - "stabbing" of dowels by hand into plastic concrete is not allowed.
- F. Do not displace or damage vapor barrier required by Section 03300.
- G. Refer to Section 03300 for minimum coverage of concrete unless noted otherwise on the Drawings.
- H. Place reinforcement, at time of concrete placing, free of mud, oil, or other materials that adversely affect or reduce bond.
- I. Reinforcement with Rust, Mill Scale, or Both: Considered satisfactory, provided minimum dimensions, including height of deformation, and weight of hand-wire-brushed test specimen are not less than ASTM A 615 requirements.
- J. Support reinforcement and fasten together to prevent displacement by construction loads of placing concrete. Use No. 16 gauge black annealed wire at all joints and crosses to accurately position reinforcing in place.
- K. Over formwork, use metal or plastic bar chairs and spacers to support reinforcement.
- L. Where concrete surface will be exposed to weather in finished structure, use noncorrosive or corrosion protected accessories within 1/2 in. of concrete surface.
- M. Where successive mats or rolls of reinforcing fabric are continuous, overlap welded wire fabric so that overlap measured between outermost cross wires of each fabric sheet is not less than spacing of cross wires plus 2 inches, not less than 12" ..
- N. Bars having splices not shown on shop drawings will be subject to rejection.
- O. Do not bend reinforcement after being embedded in hardened concrete.
- P. Do not allow bars to be in contact with dissimilar materials.

#### 3.03 FIELD QUALITY CONTROL

- A. Refer to Section 03 3000 for testing.

END OF SECTION

SECTION 03 3000 - CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SUMMARY

- A. Related Documents: General and Supplementary Conditions of the Contract, Division 1 - General Requirements, and Drawings are applicable to this Section.
- B. Section Includes:
  - 1. Cast-in-place concrete floors, foundation walls, and supported slabs.
  - 2. Floors and slabs on fill on vapor barrier.
  - 3. Equipment pads.

1.02 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01780.
- B. Accurately record actual locations of embedded utilities and components which are concealed from view.

1.03 QUALITY ASSURANCE

- A. Perform work in accordance with ACI 301, 304, 305, 306, and 309.
- B. Obtain materials from same source throughout the Work.
- C. Batch Plant: Able to show a minimum of 5 years experience in batching concrete. If required, furnish a list of similar sized jobs or special condition jobs performed during the last 2 years.

1.04 REGULATORY REQUIREMENTS

- A. Conform to applicable building code.

1.05 TESTS - GENERAL

- A. Testing, monitoring, and analysis of concrete will be performed under provisions of Section 01400.
- B. Provide free access to the work and cooperate fully with appointed testing laboratory.

1.06 SUBMITTALS

- A. Submit product data and shop drawings for specified products under provisions of Section 01300.
- B. Submit proposed mix design of each class of concrete. Establish required average strength for each class of concrete on the basis of field experience or trial mixtures, as specified by ACI 301.
- C. For trial mixtures method, employ independent testing agency acceptable to Architect and Owner for preparing, testing, and reporting proposed mix designs.
- D. All mixes will be reviewed and mix modifications made by testing laboratory only.
- E. Submit recent, maximum 60 days old tests of cement and aggregates to ensure conformance with requirements stated herein.
- F. Forward 2 copies of design mixes and cylinder break certifications for each type of concrete to Architect for review at least 10 days prior to need.
- G. Submit shop drawings indicating control joints, expansion joints, construction joints and embed locations.

1.07 COORDINATION

- A. Notify responsible trades of schedules of concrete pours so as to allow adequate time for installation of their work.
- B. Obtain anchor bolts and other miscellaneous steel items to be cast into concrete from material supplier.
- C. Coordinate size and location of mechanical equipment concrete pads with applicable trades.

1.08 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle materials in accordance with the requirements of Section 01600.
- B. Mix and deliver concrete to project ready-mixed in accordance with ASTM C94.
- C. Schedule delivery so that continuity of any pour will not be interrupted for over 15 minutes.
- D. Place concrete on site within 90 minutes after proportioning materials at batch plant.

PART 2 PRODUCTS

2.01 CONCRETE MATERIALS

- A. Cement: ASTM C 150, Normal - Type I; air entrained where exposed to the freeze-thaw cycle; gray color.
- B. Fine Aggregate: ASTM C 33, clean, hard, durable, natural sand free from silt, loam or clay.
- C. Coarse Aggregate: ASTM C 33, hard, durable, uncoated, crushed limestone or other approved aggregate.
- D. Water: Clean and not detrimental to concrete.
- E. Fly Ash: ASTM C 618, Class C or F.

2.02 ADMIXTURES

- A. Air Entrainment: ASTM C 260
  - 1. Acceptable Manufacturers: Subject to compliance with requirements herein, provide products from one of the following:
    - a. Gifford Hill/American.
    - b. Master Builders.
    - c. Sika.
- B. Chemical Admixtures: ASTM C 494, Type A - water reducing; Type B - retarding; Type C - accelerating; Type D - water reducing and retarding; Type E - water reducing and accelerating; Type F - water reducing, high range admixtures; Type G - water reducing, high range, and retarding admixtures. Add cement-dispersing agent to concrete in order to hold water-cement ratio to an absolute minimum and to maintain adequate workability. Depending upon weather conditions at time of placing, cement-dispersing agent may be supplemented by a set- retarding or set-accelerating agent to improve control of setting and, in the case of hot weather, to minimize surface checking. Introduce admixtures in quantities and according to methods recommended by manufacturers of materials approved for use. Introduce admixtures only after receiving written approval from testing laboratory and Structural Engineer.
  - 1. Acceptable Manufacturers: Subject to compliance with requirements herein, provide products from one of the following:
    - a. Gifford-Hill/American.
    - b. Master Builders.
    - c. Sika.

## 2.03 ACCESSORIES

- A. Bonding Agent: Two component modified epoxy resin;
  - 1. Acceptable Products:
    - a. Euco Epoxy by Euclid Chemical Co.
    - b. Sonobond by Sonneborn-Contech.
- B. Vapor Barrier and Moist Curing Membrane: 10 mil thick clear reinforced polyethylene film, equal to Moistop by Fortifiber.
- C. Non-shrink Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 10,000 psi in 28 days
  - 1. Acceptable Manufacturers: Subject to compliance with requirements herein, provide products from one of the following:
    - a. Master Builders.
    - b. Euclid Chemical.
    - c. Sonneborn-Contech.
- D. Joint Filler: Refer to Section 03100.
- E. Curing Materials:
  - 1. Moisture-Retaining Cover: ASTM C 171; regular curing paper, white curing paper, clear polyethylene, or white burlap-polyethylene sheet.
  - 2. Liquid Curing Compound: ASTM C 309, Type 1, clear or translucent

## 2.04 CONCRETE MIX DESIGN

- A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.
- B. Concrete Compressive Strength: As indicated on drawings when tested in accordance with ASTM C 39 at 28 days.
- C. Selection of Concrete Proportions: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI 301.
  - 1. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.
- D. Fly Ash: Limit fly ash to a maximum of 20 percent of cement content by weight.
- E. Maximum Aggregate Size: 1 inch.
- F. Slump Range: 3 inch minimum; 5 inch maximum.
- G. Admixtures:
  - 1. Use air-entraining admixture for exterior exposed concrete. Add air-entraining admixture at the manufacturer's prescribed rate to result in concrete at the point of placement having air content of 4.5 percent. Tolerance on air content as delivered shall be +/- 1.5 percent tested per ASTM C 173.
  - 2. Do not use air-entraining admixtures for concrete slabs that are to receive a hard steel trowel finish.
  - 3. Use water-reducing admixtures in strict compliance with the manufacturer's directions.

## 2.05 MIXING

- A. On Project Site: Mix in drum type batch mixer, complying with ASTM C 685. Mix each batch not less than 1-1/2 minutes and not more than 5 minutes.
- B. Transit Mixers: Comply with ASTM C 94.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify anchors, seats, plates, reinforcement, and other items to be cast into concrete are accurately placed, held securely, and will not cause hardship in placing concrete.
- B. Inspect masonry work used as forms. Do not proceed until masonry is complete and properly cured so as to withstand pressures of wet concrete.
- C. Correct unsatisfactory work prior to placing concrete.
- D. Remove rubbish from formwork immediately prior to placing concrete.
- E. Remove ice and excess water from excavations and formwork.

3.02 PREPARATION

- A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent. Apply bonding agent in accordance with manufacturer's instructions.
- B. At locations where new concrete is doweled to existing work, drill over-sized holes in existing concrete, insert steel dowels, and pack solid with non-shrink grout.
- C. Install vapor barrier under interior slabs on fill and over sand leveling bed if present. Lap joints minimum 12 inches and seal with special tape of same permeance as vapor barrier. Do not disturb or damage vapor barrier while placing concrete. Repair damaged vapor barrier.

3.03 PLACING CONCRETE

- A. Notify Architect, Engineer, Owner/PM, and testing laboratory a minimum of 48 hours prior to commencement of concreting operations.
- B. Place concrete in accordance with ACI 301 and as specified below
  - 1. Unless protection is provided, do not place concrete in rain, sleet, or snow.
  - 2. Maximum height of concrete free fall is 5 feet. Where longer drops are necessary, use a chute, tremie or other approved conveyance to assist the concrete into place without separation. Do not place directly into any excavations, including piers, where water is standing. If the place of deposit cannot be successfully pumped dry, place through a tremie with its outlet end near the bottom of the place of deposit.
  - 3. Regulate rate of placement so concrete remains plastic and flows into position.
  - 4. Deposit concrete continuously until panel or section is completed. Place as near as possible to its final location; do not rehandle.
  - 5. Place concrete in horizontal layers 18 inches maximum thickness. Exercise special care to prevent splashing the forms or reinforcement with concrete. Remove any hardened or partially hardened concrete which has accumulated on the forms or reinforcement before the work proceeds. Do not place concrete on previously deposited concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the respective member or section, except allow concrete to settle 2 hours where walls or columns are to receive superimposed loads.
  - 6. Do not place concrete, under any circumstances, except in presence of testing laboratory.
  - 7. When placing concrete in masonry, exercise extreme care to prevent concrete from staining face of masonry.
  - 8. Size and design equipment for chuting, pumping, and pneumatically conveying concrete so as to assure a practically continuous flow of concrete at the delivery end without separation of the materials. Do not use gravity-flow or aluminum chutes or conveyors for transporting concrete horizontally. Provide runways for wheeled concrete conveying equipment from the concrete delivery point to the locations of final deposit.
  - 9. Consolidation
    - a. Comply with requirements of ACI 309.

- b. Use mechanical vibrating equipment for consolidation.
  - c. Do not use vibrators to transport concrete in forms.
  - d. Use vibrators with sufficient speed and amplitude to consolidate effectively.
  - e. Keep a spare vibrator on site during all concrete pours.
  - f. Thoroughly consolidate concrete and work around reinforcement, embedded items and into corners of forms. Thoroughly consolidate layers of concrete with previous layers.
  - g. Honeycombing caused by improper consolidation is unacceptable.
10. Construction Joints: Unless otherwise shown on Drawings, construct each footing, pier, column, beam, wall and slab monolithically. Each will be considered as a single unit of work. Where construction joints are absolutely unavoidable, locate joints at or near third-points of spans where approved by Architect/Engineer. Provide appropriate keys in construction joints, plumb and level, whether horizontal or vertical. Place construction joints in exposed concrete work at detailed joints or rustications as approved by Architect/Engineer.
  11. Expansion Joint Fillers: Place pre-molded expansion joint fillers at locations as detailed and whenever required to separate site paving from building slabs. Refer to Drawings for required joint dimensions.
  12. Cold Weather Placement: Do not place concrete when temperature is below 40 degrees F unless cold weather concrete procedures are followed as specified in ACI 306. Calcium chloride shall not be used.
  13. Hot Weather Placement: Exercise special care to prevent high temperature in fresh concrete during hot weather in accordance with ACI 305. Use water reducing set-retarding admixtures in such quantities as specifically recommended by manufacturer to assure that concrete remains workable and lift lines will not be visible.
  14. Bonding: Before depositing any new concrete on or against previously deposited concrete which has partially or entirely set, thoroughly roughen and clean the surfaces of the latter of all foreign matter, scum, and laitance. Retighten forms and re-coat the surface of the previously deposited concrete with specified bonding agent per manufacturer's directions.
- C. Ensure reinforcement, inserts, embedded parts, and formed joints are not disturbed during concrete placement.
  - D. Maintain concrete cover around reinforcing as indicated on drawings.
  - E. Place concrete continuously between predetermined construction and control joints.
  - F. Place floor slabs on fill in pattern indicated on Drawings.
  - G. Saw cut control joints at an optimum time after finishing. Use 3/16 inch thick blade, cutting 1/4 into depth of slab thickness.
  - H. Separate exterior slabs on fill from vertical surfaces with joint filler. Extend joint filler from bottom of slab to within 1/4 inch of finished slab surface.
  - I. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Architect/Engineer upon discovery.
  - J. Maintain record of concrete placement. Record date, location, quantity, air temperature and test samples taken.

#### 3.04 FINISHING OF FORMED SURFACES

- A. Rough Form Finish: For formed concrete surfaces not exposed to view in the finish work or concealed by other construction. This is the concrete surface having texture imparted by form-facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4 inch in height rubbed down or chipped off.
- B. Smooth Form Finish: For formed concrete surfaces exposed to view or to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, painting, or other similar system. This is an as-cast

concrete surface obtained with selected form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch defective areas with fins and other projections completely removed and smoothed.

- C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces occurring 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.
- D. Pitch floors to drains 1/8 to 1/4 inch per foot nominal, unless otherwise shown on the drawings.

### 3.05 SLAB FINISHES:

- A. Monitoring and Adjustment: Provide continuous cycle of placement, measurement, evaluation and adjustment of procedures to produce slabs within specified tolerances.
- B. Set perimeter forms to serve as screed using either optical or laser instruments. For slabs on grade, wet screeds may be used to establish initial grade during strike-off, unless this method proves insufficient to meet required finish tolerances whereby rigid screed guides are to be used. Where wet screeds are used, they shall be placed using grade stakes set by optical or laser instruments. Use rigid screed guides, as opposed to wet screeds, to control strike-off elevation for all types of elevated (non slab-on-grade) slabs. Divide bays into halves or thirds by hard screeds. Adjust as necessary where monitoring of previous placements indicates unshored structural steel deflections to other than a level profile.
- C. Place slabs monolithically. Once slab placement commences, complete finishing operations within same day. Slope finished slab to floor drains where they occur, whether shown or not.
- D. Use straightedges specifically made for screeding, such as hollow magnesium straightedges or power strike-offs. Do not use pieces of dimensioned lumber. Strike off and screed slab to a true surface at required elevations. Use optical or laser instruments to check concrete finished surface grade after strike-off. Repeat strike-off as necessary. Complete screeding before any excess moisture or bleeding water is present on surface. Do not sprinkle dry cement on the surface.
- E. Immediately following screeding, and before any bleed water appears, use a 10 foot wide highway straightedge in a cutting and filling operation to achieve surface flatness. Do not use bull floats or darbys, except that darbying may be allowed for narrow slabs and restricted spaces.
- F. Wait until water sheen disappears and surface stiffens before proceeding further. Do not perform subsequent operations until concrete will sustain foot pressure with maximum of 1/4 inch indentation.
- G. Scratch Finish: When required by the High Performance Floor Coating Supplier / Installer, finish base slab to receive a bonded floor coating as indicated above, except that bull floats and darbys may be used. If required by floor coating supplier, thoroughly coarse wire broom within two hours after placing to roughen slab surface to insure a permanent bond between base slab and applied materials.
- H. Float Finish: Slabs to receive unbonded toppings, steel trowel finish, fill, mortar setting beds, ramps, stair treads, platforms (interior and exterior), and equipment pads shall be floated to a smooth, dense uniform, sandy textured finish. During floating, while surface is still soft, check surface for flatness using a 10 foot highway straightedge. Correct high spots by cutting down and correct low spots by filling in with material of same composition as floor finish. Remove any surface projections and re-float to a uniform texture.
- I. Steel Trowel Finish: Concrete surfaces to receive resilient floor covering or carpet, monolithic floor slabs to be exposed to view in finished work, applied toppings, and other interior surfaces for which no other finish is indicated. Steel trowel immediately following floating. During final troweling, tilt steel trowel at a slight angle and exert heavy pressure to compact cement paste and form a dense, smooth surface. Finished surface shall be smooth, free of trowel marks, and uniform in texture and appearance.

- J. Broom Finish: Finish exterior slabs, ramps, and stair treads with a bristle brush moistened with clear water after surfaces have been floated. Brush in a direction transverse to main traffic.
- K. Finished slab flatness (FF) and levelness (FL) values are to comply with the following minimum requirements:
1. Slab on Grade:  
Specified overall value           FF 25 / FL 20  
Minimum local value               FF 17 / FL 15
  2. "Specified overall value" is based on the composite of all measured values in a placement derived in accordance with ASTM E1155.
  3. "Minimum local value" (MLV) describes the flatness or levelness below which repair or replacement is required. MLV is based on the results of an individual placement and applies to a minimum local area. Minimum local area boundaries may not cross a construction joint or expansion joint. A minimum local area will be bounded by construction and/or control joints, or by column lines and/or half-column lines, whichever is smaller.
- L. Measurements
1. Owner may retain a testing laboratory to take measurements to verify compliance with FF, FL, and other finish requirements. Measurements will occur within 72 hours after completion of concrete placement (weekends and holidays excluded). Profile data for above characteristics may be collected using a laser level or any Type II apparatus (ASTM E1155, "profileograph" or "dipstick"). Contractor's surveyor shall establish reference elevations to be used by Owner retained testing laboratory.
  2. Contractor not experienced in using FF and FL criteria is encouraged to retain the services of a floor consultant to assist with recommendations concerning adjustments to slab thicknesses, finishing techniques, and procedures on measurements of the finish as it progresses in order to achieve the specific flatness and levelness numbers.
- M. Acceptance/ Rejection:
1. If individual slab section measures less than either of specified minimum local FF/FL numbers, that section shall be rejected and remedial measures shall be required. Sectional boundaries may be set at construction and contraction (control) joints, and not smaller than one-half bay.
  2. If composite value of entire slab installation, combination of all local results, measures less than either of specified overall FF/FL numbers, then whole slab shall be rejected and remedial measures shall be required.
- N. Remedial Measures for Rejected Slabs: Correct rejected slab areas by grinding, planing, surface repair with underlayment compound or repair topping, retopping, or removal and replacement of entire rejected slab areas, as directed by Resident Engineer, until a slab finish constructed within specified tolerances is accepted.
- O. Surface Treatments: Refer to Section 09960 High Performance Floor Coating.

### 3.06 CONCRETE CURING AND PROTECTION

- A. Conform to ACI 308: Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Protect exposed surfaces of concrete from premature drying, wash by rain and running water, win, mechanical injury, and excessively hot or cold temperatures. Weather permitting, keep continuously moist for not less than 7 days, except for high early strength concrete which shall be kept continuously moist for not less than 3 days.
- B. Curing Methods: Cure exposed concrete surfaces as described below. Other curing methods may be used if approved by Engineer of Record.
1. Liquid curing and sealing compounds: Apply by power driven spray or roller in accordance with the manufacturer's instructions. Apply immediately after finishing.



2. Plastic sheets: Apply as soon as concrete has hardened sufficiently to prevent surface damage. Utilize widest practical width sheet and overlap adjacent sheets a minimum of 3 inches. Tightly seal joints with tape.
  3. Paper: Utilize widest practical width paper and overlap adjacent sheets a minimum of 3 inches. Tightly seal joints with sand, wood planks, pressure-sensitive tape, mastic or glue.
- C. Curing Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces, by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by moisture cover curing method.
- D. Curing Unformed Surfaces: Cure unformed surfaces, such as slabs, floor topping, and other flat surfaces, in accordance with Section 03355.

### 3.07 MISCELLANEOUS CONCRETE ITEMS

- A. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- B. Equipment Bases and Foundations: Provide machine and equipment bases and foundations, as shown on drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with certified diagrams or templates of manufacturer furnishing machines and equipment.
- C. Reinforced Masonry: Provide concrete grout for reinforced masonry lintels and bond beams where indicated on drawings and as scheduled. Maintain accurate location of reinforcing steel during concrete placement.

### 3.08 PATCHING CONCRETE SURFACES

- A. It is the intent of these Specifications to provide for concrete wall, beam, and soffit surfaces of such quality as to require a minimum of pointing.
- B. Methods of Patching Concrete: Reviewed with and approved by Architect prior to application.
- C. Exercise care in forming, mixing and placing of concrete as to assure reasonably uniform dense surfaces, free from blemishes, voids, or honeycombs.
- D. Repair and patch defective areas with cement mortar and bonding agent mixture immediately after removal of forms, when acceptable to Architect.
1. Cut out honeycomb, rock pockets, voids over 1/4 inch in any dimension, and holes left by tie rods and bolts, down to solid concrete but in no case to a depth of less than 1 inch. Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched with specified bonding agent. Place patching mortar before bonding compound has dried.
  2. For exposed-to-view surfaces, blend white portland cement and standard portland cement so that, when dry, patching mortar will match color surrounding. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.
- E. Repair of Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Architect. Surface defects, as such include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on surface, and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes, fill with dry-pack mortar, or precast cement cone plugs secured in place with bonding agent.
1. Repair concealed formed surfaces where possible, that contain defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete.
- F. Repair of Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as

herein specified. Test unformed surfaces sloped to drain for trueness of slope and smoothness by using a template having required slope.

1. Repair finished unformed surfaces that contain defects that affect durability of concrete. Surface defects, as such, include crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through non-reinforced sections regardless of width, spalling, popouts, honeycomb, rock pockets, and other objectionable conditions.
  2. Correct high areas in unformed surfaces by grinding after concrete has cured at least 14 days.
  3. Correct low areas in unformed surfaces during or immediately after completion of surface finishing operations by cutting out low areas and replacing with patching compound. Finish repaired areas to blend into adjacent concrete. Proprietary underlayment compounds may be used when acceptable to Architect. Refer to Section 03542 for cementitious patching compound.
  4. Repair defective areas, except random cracks and single holes not exceeding 1 inch in diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least 3/4 inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding compound. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
- G. Repair isolated random cracks and single holes not over 1 inch in diameter by dry-pack method. Groove top of cracks and cut out holes to sound concrete and clean of dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Mix dry-pack, consisting of one part portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Place dry-pack before bonding compound has dried. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for not less than 72 hours.
- H. Perform structural repairs with prior approval of Architect for method and procedure, using specified epoxy adhesive and mortar.
- I. Repair methods not specified above may be used, subject to acceptance of Architect.

### 3.09 DEFECTIVE CONCRETE

- A. Modify or replace, at Architect's option, concrete not conforming to required levels and lines, details, elevations and appearance. Removal and replacement shall not impair the strength or appearance of the structure.
- B. Repair or replace concrete not properly placed or of the specified type.

### 3.010 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 01400.
- B. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.
- C. Every load of concrete shall be tested for slump, air entrainment, and compressive strength cylinders as specified in this section.
- D. Testing laboratory is to be present during every concrete placement.
- E. Formwork, Reinforcing Steel and Inserts
  1. Prior to each concrete pour, inspect formwork for tightness of joints, proper shoring and bracing, and location of rustications, in accordance with ACI 347.
  2. Prior to each concrete pour, inspect fabrication and bending of bars, bar sizes, spacing, placement and tying in accordance with ACI 315.

3. Prior to each concrete pour, inspect positioning of steel inserts and assemblies, sizes, and spacing, and test fusion-welded anchors and shear connectors.

F. Cast-in-Place Concrete

1. Design Mixes
  - a. Concrete mixtures to be reviewed by testing laboratory.
  - b. At the beginning of the work, submit proposed concrete mixes for review by Architect/Engineer and testing laboratory, including the sieve analysis of fine and coarse aggregate ASTM C 136, dry rodded weight of coarse aggregate, ASTM C 29, and the specific gravity (bulk saturated surface dry), of fine and coarse aggregates ASTM C 127 and C 128. Laboratory will review and make mix modification recommendations.
  - c. Do not mix concrete for placing in the work until after laboratory reports reflect that each proposed mix will develop the strength required.
2. Test Cylinders: Make at least one test of each day's pouring or each 50 cubic yards, whichever comes first, on each different portion or section of the work. Mold and cure specimens in accordance with ASTM C 31, and test in accordance with ASTM C 39. Test cylinders shall be made and tested by the laboratory in accordance with ASTM C 172. Footings, walls, and floor systems constitute different sections. Each test shall consist of 5 specimens, 2 of which shall be broken at 7 days, 2 at 28 days and one held in reserve. Determine temperature and air content for each set of test cylinders in accordance with ASTM C 231.
3. Field Quality Control
  - a. Determine slump for each strength test and whenever consistency of concrete appears to vary, in accordance with ASTM C 143. Do not allow water to be added to the mix, especially after slump tests are performed.
  - b. Monitor addition of water to concrete and length of time concrete is allowed to remain in truck.
  - c. Certify delivery tickets indicating class of concrete, amount of water added during initial batching, and time initial batching occurred.
  - d. Monitor work being performed in accordance with ACI recommendations as a standard of quality.
  - e. Test for air entrainment on all concrete exposed to the elements.
4. Source Quality Control: Periodically inspect and control concrete mixing and loading of transit mix trucks at batch plant at intervals as agreed to by Architect/Engineer and laboratory personnel.

3.011 PROTECTION

- A. Protect finished work under provisions of Section 01500.
- B. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, rain or running water and mechanical injury.
- C. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

3.012 SCHEDULE

- A. Reference drawings for schedule of concrete 28-day compressive strength.

END OF SECTION

SECTION 042000 - UNIT MASONRY

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 unit masonry assemblies consisting of the following:
  - 1. Concrete Masonry Units.
  - 2. Face brick.
  - 3. Mortar and grout.
  - 4. Ties and anchors.
  - 5. Embedded flashing.
  - 6. Miscellaneous masonry accessories.
- B. Related Sections include the following:
  - 1. Division 07 Section "Roof Specialties".
  - 2. Division 07 Section "Joint Sealants" for sealing control and expansion joints in unit masonry.
- C. Products furnished, but not installed, under this Section include the following:
  - 1. Anchor sections of adjustable masonry anchors for connecting to structural frame, installed under Division 05 Section "Structural Steel Framing."
- D. Products installed, but not furnished, under this Section include the following:
  - 1. Steel lintels and shelf angles for unit masonry, furnished under Division 05 Section "Metal Fabrications."

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
  - 2. Include test reports, per ASTM C 780, for mortar mixes required to comply with property specification.
  - 3. Include test reports, per ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1093 for testing indicated, as documented according to ASTM E 548.

- B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.
- C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from a single manufacturer for each cementitious component and from one source or producer for each aggregate.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

#### 1.6 PROJECT CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
- B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
  - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
  - 2. Protect sills, ledges, and projections from mortar droppings.
  - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
  - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- C. 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.
  - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

- D. 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 exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in the completed Work or will impair the quality of completed masonry

### 2.2 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
- B. Integral Water Repellent: Provide units made with integral water repellent for exposed units.
1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested according to ASTM E 514 as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, shall show no visible water or leaks on the back of test specimen.
    - a. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) ACM Chemistries; RainBloc.
      - 2) BASF Aktiengesellschaft; Rheopel Plus.
      - 3) Grace Construction Products, W. R. Grace & Co. - Conn.; Dry-Block.
- C. Decorative CMUs: ASTM C 90.
1. Products: Subject to compliance with requirements, provide as indicated on Drawings.
  2. Density Classification: Normal weight.
  3. Pattern and Texture: Standard pattern split-face finish.
  4. Colors: As indicated on Drawings.

### 2.3 BRICK

- A. General: Provide shapes indicated and as follows:
1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
  2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
  3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.

4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

B. Face Brick: ASTM C 216, Grade SW, Type FBX.

1. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested per ASTM C 67.
2. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
3. Surface Coating: Brick with colors or textures produced by application of coatings shall withstand 50 cycles of freezing and thawing per ASTM C 67 with no observable difference in the applied finish when viewed from 10 feet.
4. Size (Actual Dimensions): 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long.
5. Application: Use where brick is exposed, unless otherwise indicated.
6. Color and Texture: As indicated on Drawings.
7. Products: As indicated on Drawings.

2.4 MORTAR AND GROUT MATERIALS

- A. 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.

- B. Hydrated Lime: ASTM C 207, Type S.

- C. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I or Type III, and hydrated lime complying with ASTM C 207, Type S.

- D. Masonry Cement: ASTM C 91.

1. Products: As indicated on the drawings.

- E. Mortar Cement: ASTM C 1329.

1. Products: As indicated on the drawings.

- F. Aggregate for Mortar: ASTM C 144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.

- G. Aggregate for Grout: ASTM C 404.

- H. 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:

- a. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Morset.

- I. Water: Potable.

2.5 TIES AND ANCHORS

- A. Materials: Provide ties and anchors specified in subsequent paragraphs that are made from materials that comply with eight subparagraphs below, unless otherwise indicated.
1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82; with ASTM A 153/A 153M, Class B-2 coating.
  2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 316.
  3. Galvanized Steel Sheet: ASTM A 653/A 653M, Commercial Steel, G60 zinc coating.
  4. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, hot-dip galvanized after fabrication to comply with ASTM A 153/A 153M.
  5. Stainless-Steel Sheet: ASTM A 666, Type 304.
- B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches parallel to face of veneer.
- C. Adjustable Anchors for Connecting to Structure: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Tie Section for Steel Frame: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from 0.25-inch-diameter, hot-dip galvanized steel wire.

## 2.6 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing:
1. Stainless Steel: ASTM A 240/A 240M, Type 304, 0.016 inch thick.
  2. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
  3. Fabricate through-wall metal flashing embedded in masonry from stainless steel, with ribs at 3-inch intervals along length of flashing to provide an integral mortar bond.
  4. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
  5. Fabricate through-wall flashing with drip edge, unless otherwise indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
  6. Fabricate metal drip edges and sealant stops for ribbed metal flashing from plain metal flashing of same metal as ribbed flashing and extending at least 3 inches into wall with hemmed inner edge to receive ribbed flashing and form a hooked seam. Form hem on upper surface of metal so that completed seam will shed water.
  7. Metal Expansion-Joint Strips: Fabricate from stainless steel copper to shapes indicated.
- 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 0.040 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-Wall 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.
- b. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
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.
  - b. Monolithic Sheet: Elastomeric thermoplastic flashing, 0.040 inch thick.
  - c. Self-Adhesive Sheet: Elastomeric thermoplastic flashing, 0.025 inch thick, with a 0.015-inch-thick coating of adhesive.
  - d. Self-Adhesive Sheet with Drip Edge: Elastomeric thermoplastic flashing, 0.025 inch thick, with a 0.015-inch-thick coating of rubberized-asphalt adhesive. Where flashing extends to face of masonry, rubberized-asphalt coating is held back approximately 1-1/2 inches from edge.
    - 1) Color: Black.
  - e. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
3. EPDM Flashing: Sheet flashing product made from ethylene-propylene-diene terpolymer, complying with ASTM D 4637, 0.040 inch thick.
- a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) Carlisle Coatings & Waterproofing; Pre-Kleened EPDM Thru-Wall Flashing.
    - 2) Firestone Specialty Products; FlashGuard.
    - 3) Heckmann Building Products Inc.; No. 81 EPDM Thru-Wall Flashing.
    - 4) Hohmann & Barnard, Inc.; Epra-Max EPDM Thru-Wall Flashing.
    - 5) Sandell Manufacturing Co., Inc.; EPDM Flashing.

C. Application: Unless otherwise indicated, use the following:

1. Where flashing is indicated to receive counterflashing, use metal flashing.
2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge or flexible flashing with a metal drip edge.
4. Where flashing is fully concealed, use metal flashing or flexible flashing.

- D. Solder and Sealants for Sheet Metal Flashings:
  - 1. Solder for Stainless Steel: ASTM B 32, Grade Sn60, with a flux of type recommended by stainless-steel sheet manufacturer.
  - 2. Solder for Copper: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead.
- 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; of width and thickness indicated; formulated from neoprene.
- B. Weep/Vent Products: Use the following, unless otherwise indicated:
  - 1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.
    - a. Products:
      - 1) Hohmann & Barnard, Inc.; Quadro-Vent.
- C. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
  - 1. Provide one of the following configurations:
    - a. Strips, not less than 3/4 inch thick and 10 inches wide, with dimpled surface designed to catch mortar droppings and prevent weep holes from being clogged with mortar.
    - b. Sheets or strips full depth of cavity and installed to full height of cavity.
  - 2. Products:
    - a. Advanced Building Products Inc.; Mortar Break.
    - b. Archovations, Inc.; CavClear Masonry Mat.
    - c. Dayton Superior Corporation, Dur-O-Wal Division; Polytite MortarStop.
    - d. Mortar Net USA, Ltd.; Mortar Net.

## 2.8 MASONRY CLEANERS

- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

## 2.9 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. Limit cementitious materials in mortar to portland cement and lime.
  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 or needed to provide required compressive strength of masonry.
1. For masonry below grade or in contact with earth, use Type S.
  2. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type S.
  3. For interior non-load-bearing partitions, Type S.
- D. Pigmented Mortar: Use colored cement product.
1. Pigments shall not exceed 10 percent of portland cement by weight.
  2. Pigments shall not exceed 5 percent of masonry cement by weight.
  3. Mix to match Architect's sample.
- E. Grout for Unit Masonry: Comply with ASTM C 476.
1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
  2. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
  2. Verify that foundations are within tolerances specified.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

- B. Build chases and recesses to accommodate items specified in this and other Sections.
- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- D. 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.
- E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
  - 1. Mix units from several pallets or cubes as they are placed.
- F. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.
- G. Comply with construction tolerances in ACI 530.1/ASCE 6/TMS 602 and with the following:
  - 1. 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.
  - 2. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
  - 3. 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.
  - 4. For exposed 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. Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
  - 5. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
  - 6. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.
  - 7. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

### 3.3 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Fill space between steel frames and masonry solidly with mortar, unless otherwise indicated.
- G. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above, unless otherwise indicated.
  - 1. Install compressible filler in joint between top of partition and underside of structure above.
  - 2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c., unless otherwise indicated.
  - 3. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.

### 3.4 MORTAR BEDDING AND JOINTING

- A. Lay masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- 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.

### 3.5 ANCHORING MASONRY TO STRUCTURAL MEMBERS

- A. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:
  - 1. Provide an open space not less than 1/2 inch in width between masonry and structural member, unless otherwise indicated. Keep open space free of mortar and other rigid materials.
  - 2. Anchor masonry to structural members with anchors embedded in masonry joints and attached to structure.
  - 3. Space anchors as indicated, but not more than 16 inches o.c. vertically and 16 inches o.c. horizontally.

### 3.6 CONTROL AND EXPANSION JOINTS

- A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form expansion joints in brick made from clay or shale as follows:
  - 1. Build flanges of metal expansion strips into masonry. Lap each joint 4 inches in direction of water flow. Seal joints below grade and at junctures with horizontal expansion joints if any.
  - 2. Build flanges of factory-fabricated, expansion-joint units into masonry.
  - 3. Build in compressible joint fillers where indicated.

4. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Division 07 Section "Joint Sealants."
- C. Provide horizontal, pressure-relieving joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Division 07 Section "Joint Sealants," but not less than 3/8 inch.
1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

### 3.7 LINTELS

- A. Install steel lintels where indicated.
- B. Provide minimum bearing of 8 inches at each jamb, unless otherwise indicated.

### 3.8 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, 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 and shelf angles at all openings, 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. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Division 07 Section "Joint Sealants" for application indicated.
  4. Install metal drip edges with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Division 07 Section "Joint Sealants" for application indicated.
- C. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.
- D. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:
  1. Use specified weep/vent products or open head joints to form weep holes.
  2. Space weep holes 24 inches o.c., unless otherwise indicated.
- E. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in Part 2 "Miscellaneous Masonry Accessories" Article.

### 3.9 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
  - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
  - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
  - 3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
  - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
  - 5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
  - 6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

### 3.10 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

END OF SECTION 042000

SECTION 04 4301 - STONE MASONRY VENEER

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes stone veneer in the following applications:
  - 1. Anchored to cold-formed metal framing and sheathing.
- B. Products installed, but not furnished, in this Section include steel lintels and shelf angles for stone veneer assemblies specified in Division 5 Section "Metal Fabrications."

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. For stone varieties proposed for use on Project, include data on physical properties required by referenced ASTM standards.
- B. Stone Samples: For each color, grade, finish, and variety of stone required.
- C. Colored Mortar Samples: For each color required.
- D. Qualification Data: For Installer.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: An installer who employs experienced stone masons and stone fitters who are skilled in installing stone veneer assemblies similar in material, design, and extent to those indicated for this Project and whose projects have a record of successful in-service performance.
- B. Mockups: Build mock ups to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution.
  - 1. Build mockups for each type of stone veneer assembly in sizes approximately 48 inches (1200 mm) long by 48 inches (1200 mm) high by full thickness, including face and backup.

1.4 PROJECT CONDITIONS

- A. Protection of Stone Veneer Assemblies: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work.
- B. Stain Prevention: Immediately remove mortar and soil to prevent them from staining the face of stone veneer assemblies.
- C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.



1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and above and will remain so until masonry has dried.
- D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

## PART 2 - PRODUCTS

### 2.1 STONE SOURCES

- A. Varieties and Sources: Subject to compliance with requirements, provide one of the following stone varieties from one of the following sources:
1. Espinosa Stone - Grand Prairie TX / Capitol Products, Inc,

### 2.2 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified.
  2. Products: Subject to compliance with requirements, provide one of the products specified.

### 2.3 STONE

- A. Autumn Blend
1. Classification: I (Low-Density).
  2. Classification: II (Medium-Density).
  3. Classification: III (High-Density) except change requirements per ASTM C 568 for density, absorption by weight, and modulus of rupture to, respectively, 150 lb/cu. ft. (2400 kg/cu. m) minimum, 5 percent maximum, and 800 psi (5.5 MPa) minimum.
  4. Classification: III (High-Density).

### 2.4 MORTAR MATERIALS

- A. 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.
1. Low-Alkali Cement: Not more than 0.60 percent total alkali when tested according to ASTM C 114.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Masonry Cement: ASTM C 91.
- D. For pigmented mortar, use a colored cement formulation as required to produce color indicated or, if not indicated, as selected from manufacturer's standard formulations.

1. Products:
  - a. Colored Portland Cement-Lime Mix:
    - 1) Blue Circle Cement; Eaglebond.
    - 2) Glen-Gery Corporation; Color Mortar Blend.
    - 3) Holnam, Inc.; Rainbow Mortamix Custom Color Cement/Lime.
    - 4) Lafarge Corporation; Centurion Colorbond PL.
    - 5) Lehigh Portland Cement Co.; Lehigh Custom Color Portland/Lime.
    - 6) Riverton Corporation (The); Riverton Portland Cement Lime Custom Color.
  - b. Colored Masonry Cement:
    - 1) Blue Circle Cement; Magnolia Masonry Cement.
    - 2) Essroc Materials, Inc.; Brixment-in-Color.
    - 3) Holnam, Inc.; Rainbow Mortamix Custom Color Masonry Cement.
    - 4) Lafarge Corporation; Centurion Colorbond.
    - 5) Lehigh Portland Cement Co.; Lehigh Custom Color Masonry Cement.
    - 6) National Cement Company, Inc.; Coosa Masonry Cement.
    - 7) Riverton Corporation (The); Flamingo Color Masonry Cement.
    - 8) Southdown, Inc.; Richcolor Masonry Cement.

E. Aggregate: ASTM C 144 and as follows:

1. For pointing mortar, use aggregate graded with 100 percent passing No. 16 (1.18-mm) sieve.
2. White Aggregates: Natural white sand or ground white stone.
3. Colored Aggregates: Natural-colored sand or ground marble, granite, or other sound stone; of color necessary to produce required mortar color.

F. Mortar Pigments: Natural or synthetic iron oxides, compounded for use in mortar mixes and with a record of satisfactory performance in stone masonry mortars.

1. Products:
  - a. Bayer Corporation, Industrial Chemicals Div.; Bayferrox Iron Oxide Pigments.
  - b. Davis Colors; True Tone Mortar Colors.
  - c. Lafarge Corporation; Centurion Pigments.
  - d. Solomon Colors; SGS Mortar Colors.

G. Latex additive (water emulsion) described below, serving as replacement for part of or all gaging water, of type specifically recommended by latex-additive manufacturer for use with job-mixed portland cement mortar and not containing a retarder.

1. Latex Additive: Styrene-butadiene rubber or acrylic resin.

H. Water: Potable.

## 2.5 VENEER ANCHORS

A. Materials:

1. Hot-Dip Galvanized Steel Sheet: ASTM A 366/A 366M, cold-rolled, carbon-steel sheet hot-dip galvanized after fabrication to comply with ASTM A 153/A 153M, Class B-2.
2. Stainless-Steel Sheet: ASTM A 666, Type 304.

- B. Corrugated-Metal Veneer Anchors: Not Allowed
- C. Adjustable Veneer Anchors: 2-piece assemblies that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to wall, for attachment over sheathing to wood or metal studs, and that are capable of withstanding a 100-lbf (445-N) load in both tension and compression without deforming or developing play in excess of 0.05 inch (1.3 mm).
  - 1. Screw-Attached Veneer Anchors: Units with triangular wire tie and rib-stiffened, sheet metal anchor section with screw holes top and bottom and with raised rib-stiffened strap stamped into center to provide a slot for connection of wire tie.
    - a. Products:
      - 1) Dur-O-Wal, a Dayton Superior Company; D/A 213 or D/A 210 with D/A 700-708.
      - 2) Heckmann Building Products, Inc.; 315-D with 316.
      - 3) Hohmann & Barnard, Inc.; DW-10.
      - 4) Masonry Reinforcing Corporation of America; 1004, Type III.

## 2.6 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Fabricate from the following metal complying with requirements specified in Division 7 Section "Sheet Metal Flashing and Trim" and below:
  - 1. Material: Stainless steel, 0.0156 inch (0.4 mm) thick.
- B. Contractor's Option for Concealed Flashing: For flashing partly exposed to the exterior, use metal flashing specified above. For flashing not exposed to the exterior, use one of the following, unless otherwise indicated:
  - 1. Copper-Laminated Flashing: 5- oz./sq. ft. (1.5-kg/sq. m) sheet copper bonded with asphalt between 2 layers of glass-fiber cloth.
    - a. Products:
      - 1) Advanced Building Products, Inc.; Copper Fabric Flashing.
      - 2) AFCO Products, Inc.; Copper Fabric.
      - 3) Hohmann & Barnard, Inc.; H & B C-Fab Flashing.
      - 4) Phoenix Building Products; Type FCC-Fabric Covered Copper.
      - 5) Polytite Manufacturing Corp.; Copper Fabric Flashing.
      - 6) Sandell Manufacturing Co., Inc.; Copper Fabric Flashing.
      - 7) York Manufacturing, Inc.; York Copper Fabric Flashing.
  - 2. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable and highly adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of 0.030 inch (0.8 mm).
    - a. Products:
      - 1) Dur-O-Wal, a Dayton Superior Company; Dur-O-Barrier.
      - 2) Grace, W. R. & Co., Construction Products Division; Perm-A-Barrier Wall Flashing.
      - 3) Hohmann & Barnard, Inc.; Textroflash.
      - 4) Polyguard Products, Inc.; Polyguard 300.
      - 5) Polytite Manufacturing Corp.; Poly-Barrier Self-Adhering Wall Flashing.

- 6) Williams Products, Inc.; Everlastic MF-40.

## 2.7 MISCELLANEOUS MASONRY ACCESSORIES

- A. Weep Holes:
  1. Round Plastic Tubing: Medium-density polyethylene, 3/8-inch (10-mm) OD by thickness of stone veneer assembly.
  2. Wicking Material: Cotton or polyester rope, 1/4 to 3/8 inch (6 to 10 mm) in diameter, in length required to produce 2-inch (50-mm) exposure on exterior and 18 inches (450 mm) in cavity behind stone veneer assembly.
- B. Cavity Drainage Material: 1-inch- (25-mm-) thick, free-draining mesh made from polyethylene strands.
  1. Products:
    - a. Advanced Building Products, Inc.; Mortar Break.
    - b. CavClear; CavClear Masonry Mat.
    - c. Mortar Net USA, Ltd.; Mortar Net.
    - d. Polytite Manufacturing Corp.; Mortar Stop.

## 2.8 MASONRY CLEANERS

- A. Job-Mixed Detergent Solution: Solution of 1/2-cup (0.14-L) dry-measure tetrasodium polyphosphate and 1/2-cup (0.14-L) dry-measure laundry detergent dissolved in 1 gal. (4 L) of water.
- B. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from stone masonry surfaces without discoloring or damaging masonry surfaces; expressly approved for intended use by stone producer.
  1. Products:
    - a. Diedrich Technologies, Inc.; 101G Granite, Terra Cotta, and Brick Cleaner.
    - b. Diedrich Technologies, Inc.; 202 New Masonry Detergent.
    - c. Dominion Restoration, Inc.; DR-60 Stone and Masonry Cleaner.
    - d. Hydrochemical Techniques, Inc.; Hydroclean Brick, Granite, Sandstone and Terra Cotta Cleaner (HT-626).
    - e. ProSoCo, Inc.; Sure Klean No. 600 Detergent.
    - f. ProSoCo, Inc.; Sure Klean Restoration Cleaner.

## 2.9 STONE FABRICATION

- A. General: Fabricate stone in sizes and shapes necessary to comply with requirements indicated, including details on Drawings.
- B. Gage backs of stones for adhered veneer if more than 81 sq. in. (522 sq. cm) in area.
- C. Shape stone for type of masonry (pattern) as follows:
  1. Split-bed, random-range ashlar with random course heights and random lengths (interrupted coursed).

- D. Finish exposed faces and edges of stone to comply with requirements indicated for finish and to match approved samples and mockups.
  - 1. Finish: Natural cleft.
  - 2. Finish for Lintels: Smooth, machine finish.

## 2.10 MORTAR 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.
  - 2. Mixing Pointing Mortar: Thoroughly mix cementitious and aggregate materials together before adding water. Then mix again, adding only enough water to produce a damp, unworkable mix that will retain its form when pressed into a ball. Maintain mortar in this dampened condition for one to two hours. Add remaining water in small portions until mortar reaches desired consistency. Use mortar within 30 minutes of final mixing; do not retemper or use partially hardened material.
- B. Mortar for Stone Masonry: Comply with ASTM C 270, Proportion Specification.
  - 1. Limit cementitious materials in mortar to portland cement, mortar cement, and lime.
  - 2. Mortar for Setting Stone: Type S.
  - 3. Mortar for Pointing Stone: Type N.
- C. Latex-Modified Portland Cement Setting Mortar: Proportion and mix portland cement, aggregate, and latex additive to comply with latex-additive manufacturer's written instructions.
- D. Cement-Paste Bond Coat: Mix either neat cement and water or cement, sand, and water to a consistency similar to that of thick cream.
  - 1. For latex-modified portland cement setting-bed mortar, substitute latex admixture for part or all of water, according to latex-additive manufacturer's written instructions.
- E. Mortar for Scratch Coat over Metal Lath: 1 part portland cement, 1/2 part lime, 5 parts loose damp sand, and enough water to produce a workable consistency.
- F. Mortar for Scratch Coat over Unit Masonry: 1 part portland cement, 1 part lime, 7 parts loose damp sand, and enough water to produce a workable consistency.
- G. Pigmented Mortar: Select and proportion pigments with other ingredients to produce color required.
  - 1. Pigments shall not exceed 10 percent of portland cement by weight.
  - 2. Pigments shall not exceed 5 percent of masonry cement by weight.

## PART 3 - EXECUTION

### 3.1 SETTING OF STONE VENEER, GENERAL

- A. Accurately mark stud centerlines on face of building paper or building wrap before beginning stone installation.
- B. Coat concrete backup with asphalt dampproofing.

- C. Arrange and trim stones for accurate fit in three-course, random-range ashlar pattern with random course heights, random lengths (interrupted coursed), and uniform joint widths.
- D. Maintain uniform joint widths except for variations due to different stone sizes and where minor variations are required to maintain bond alignment, if any. Lay walls with joints not less than 1/4 inch (6 mm) at narrowest points nor more than 5/8 inch (16 mm) at widest points.
- E. Install embedded flashing and weep holes at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.
  - 1. At cold-formed metal-framed walls, extend flashing from exterior face of veneer, through the veneer, up the face of sheathing at least 8 inches (200 mm), and behind building paper or building wrap.
  - 2. At lintels and shelf angles, extend flashing full length of angles but not less than 4 inches (100 mm) into masonry at each end.
  - 3. At heads and sills, extend flashing 4 inches (100 mm) at ends and turn up not less than 2 inches (50 mm) to form a pan.
  - 4. Extend sheet metal flashing 1/2 inch (13 mm) beyond face of masonry at exterior and turn flashing down to form a drip.
  - 5. Install metal drip edges beneath flashing at exterior face of wall. Stop flashing 1/2 inch (13 mm) back from outside face of wall and adhere flashing to top of metal drip edge.
- F. Place weep holes and vents in joints where moisture may accumulate, including at base of cavity walls, above shelf angles, and at flashing.
  - 1. Use round plastic tubing or wicking material to form weep holes.
  - 2. Use wicking material to form weep holes above flashing in stone sills. Turn wicking down at lip of sill to be as inconspicuous as possible.
  - 3. Space weep holes 16 inches (400 mm) o.c.
  - 4. Place cavity drainage material immediately above flashing in cavities.
- G. Trim wicking material used in weep holes flush with outside face of wall after mortar has set.
- H. Install vents in vertical head joints at the top of each continuous cavity at spacing indicated. Use round plastic tubing or open head joints to form vents.

### 3.2 CONSTRUCTION TOLERANCES

- A. Variation from Plumb: For vertical lines and surfaces, do not exceed 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (10 mm in 6 m), or 1/2 inch in 40 feet (13 mm in 12 m) or more. For external corners, expansion joints, control joints, and other conspicuous lines, do not exceed 1/4 inch in 20 feet (6 mm in 6 m) or 1/2 inch in 40 feet (13 mm in 12 m) or more.
- B. Variation from Level: For bed joints and lines of exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines, do not exceed 1/4 inch in 20 feet (6 mm in 6 m) or 1/2 inch in 40 feet (13 mm in 12 m) or more.
- C. Variation of Linear Building Line: For position shown in plan, do not exceed 1/2 inch in 20 feet (13 mm in 6 m) or 3/4 inch in 40 feet (19 mm in 12 m) or more.

### 3.3 INSTALLATION OF ANCHORED STONE VENEER ASSEMBLIES

- A. Anchor stone veneer to cold-formed metal framing with adjustable, screw-attached veneer anchors as follows:
  - 1. Fasten each anchor section through sheathing to framing with two screws.
  - 2. Embed wire tie section in mortar joints to within 1-1/2 inches (38 mm) of face.
- B. Space veneer anchors not more than 18 inches (450 mm) o.c. vertically and 32 inches (800 mm) o.c. horizontally, with not less than 1 veneer anchor per 2.67 sq. ft. (0.25 sq. m) of wall area. Install additional veneer anchors within 12 inches (300 mm) of openings, sealant joints, and perimeter at intervals not exceeding 12 inches (300 mm).
- C. Set stone in full bed of mortar with full head joints, unless otherwise indicated. Build veneer anchors into mortar joints as stone is set.
- D. Provide 1-inch air space between stone veneer assemblies and backup construction, unless otherwise indicated. Keep air space free of mortar droppings and debris.
  - 1. Place mortar spots in cavity at veneer anchors to maintain spacing.
  - 2. Slope beds toward air space to minimize mortar protrusions into air space. As work progresses, trowel mortar fins protruding into air space flat against back of veneer.
- E. Rake out joints for pointing with mortar to depth of not less than 1/2 inch (13 mm). Rake joints to uniform depths with square bottoms and clean sides.

### 3.4 POINTING

- A. Prepare stone-joint surfaces for pointing with mortar by removing dust and mortar particles. Where setting mortar was removed to depths greater than surrounding areas, apply pointing mortar in layers not more than 3/8 inch (10 mm) deep until a uniform depth is formed.
- B. Point stone joints by placing and compacting pointing mortar in layers not more than 3/8 inch (10 mm) deep. Compact each layer thoroughly and allow to become thumbprint hard before applying next layer.
- C. Tool joints, when pointing mortar is thumbprint hard, with a smooth jointing tool to produce the following joint profile:
  - 1. Joint Profile: Concave.

### 3.5 ADJUSTING AND CLEANING

- A. In-Progress Cleaning: Clean stone veneer assemblies as work progresses. Remove mortar fins and smears before tooling joints.
- B. Final Cleaning: After mortar is thoroughly set and cured, clean stone veneer assemblies as follows:
  - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
  - 2. Test cleaning methods on mockup; leave one-half of panel uncleaned for comparison purposes.
  - 3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner.
  - 4. Wet wall surfaces with water before applying cleaner; remove cleaner promptly by rinsing thoroughly with clear water.

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5. Clean stone veneer assemblies by bucket and brush hand-cleaning method described in BIA Technical Note No. 20 Revised II, using job-mixed detergent solution.
6. Clean limestone veneer assemblies to comply with recommendations in ILI's "Indiana Limestone Handbook."

3.6 EXCESS MATERIALS AND WASTE

- A. Disposal as Fill Material: Dispose of clean masonry waste, including mortar and excess or soil-contaminated sand, 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.

END OF SECTION 04 301



SECTION 047200 - CAST STONE MASONRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Cast stone.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for cast stone units. Include dimensions, details of reinforcement and anchorages if any, and indication of finished faces.
  - 1. Include building elevations showing layout of units and locations of joints and anchors.
- C. Samples for Initial Selection: For colored mortar.
- D. Samples for Verification:
  - 1. For each color and texture of cast stone required, 10 inches square in size.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer of cast stone units similar to those indicated for this Project, that has sufficient production capacity to manufacture required units, and is a plant certified by the Architectural Precast Association.
- B. Source Limitations for Cast Stone: Obtain cast stone units through single source from single manufacturer.
- C. Mockups: Furnish cast stone for installation in mockups specified in Division 04 Section "Unit Masonry."

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Coordinate delivery of cast stone with unit masonry work to avoid delaying the Work and to minimize the need for on-site storage.
- B. Pack, handle, and ship cast stone units in suitable packs or pallets.
  - 1. Lift with wide-belt slings; do not use wire rope or ropes that might cause staining. Move cast stone units, if required, using dollies with wood supports.
  - 2. Store cast stone units on wood skids or pallets with nonstaining, waterproof covers, securely tied. Arrange to distribute weight evenly and to prevent damage to units. Ventilate under covers to prevent condensation.

- C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- D. Store mortar aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

## 1.5 PROJECT CONDITIONS

- A. Comply with requirements of Division 04 Section "Unit Masonry."

## PART 2 - PRODUCTS

### 2.1 CAST STONE MATERIALS

- A. General: Comply with ASTM C 1364 and the following:
  - B. Portland Cement: ASTM C 150, Type I or Type III, containing not more than 0.60 percent total alkali when tested according to ASTM C 114. Provide natural color or white cement as required to produce cast stone color indicated.
  - C. Coarse Aggregates: Granite, quartz, or limestone complying with ASTM C 33; gradation and colors as needed to produce required cast stone textures and colors.
  - D. Fine Aggregates: Natural sand or crushed stone complying with ASTM C 33, gradation and colors as needed to produce required cast stone textures and colors.
  - E. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
  - F. Admixtures: Use only admixtures specified or approved in writing by Architect.
    - 1. Do not use admixtures that contain more than 0.1 percent water-soluble chloride ions by mass of cementitious materials. Do not use admixtures containing calcium chloride.
    - 2. Use only admixtures that are certified by manufacturer to be compatible with cement and other admixtures used.
    - 3. Air-Entraining Admixture: ASTM C 260. Add to mixes for units exposed to the exterior at manufacturer's prescribed rate to result in an air content of 4 to 6 percent, except do not add to zero-slump concrete mixes.
    - 4. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
    - 5. Water-Reducing, Retarding Admixture: ASTM C 494/C 494M, Type D.
    - 6. Water-Reducing, Accelerating Admixture: ASTM C 494/C 494M, Type E.
  - G. Reinforcement: Deformed steel bars complying with ASTM A 615/A 615M, Grade 60. Use galvanized or epoxy-coated reinforcement when covered with less than 1-1/2 inches of cast stone material.
    - 1. Epoxy Coating: ASTM A 775/A 775M.
    - 2. Galvanized Coating: ASTM A 767/A 767M.
  - H. Embedded Anchors and Other Inserts: Fabricated from steel complying with ASTM A 36/A 36M, and hot-dip galvanized to comply with ASTM A 123/A 123M.

## 2.2 CAST STONE UNITS

- A. Basis of Design: Subject to compliance with requirements, provide the basis of design products as follows or a comparable product by another manufacturer:
1. Field Cast Stone Basis of Design: Reading Rock – RockCast®, as indicated on drawing.
- B. Provide cast stone units complying with ASTM C 1364 using either the vibrant dry tamp or wet-cast method.
1. Provide units that are resistant to freezing and thawing as determined by laboratory testing according to ASTM C 666/C 666M, Procedure A, as modified by ASTM C 1364.
- C. Fabricate units with sharp arris and accurately reproduced details, with indicated texture on all exposed surfaces unless otherwise indicated.
1. Slope exposed horizontal surfaces 1:12 to drain unless otherwise indicated.
  2. Provide raised fillets at backs of sills and at ends indicated to be built into jambs.
  3. Provide drips on projecting elements unless otherwise indicated.
- D. Fabrication Tolerances:
1. Variation in Cross Section: Do not vary from indicated dimensions by more than 1/8 inch.
  2. Variation in Length: Do not vary from indicated dimensions by more than 1/360 of the length of unit or 1/8 inch, whichever is greater, but in no case by more than 1/4 inch.
  3. Warp, Bow, and Twist: Not to exceed 1/360 of the length of unit or 1/8 inch, whichever is greater.
  4. Location of Grooves, False Joints, Holes, Anchorages, and Similar Features: Do not vary from indicated position by more than 1/8 inch on formed surfaces of units and 3/8 inch on unformed surfaces.
- E. Cure units as follows:
1. Cure units in enclosed moist curing room at 95 to 100 percent relative humidity and temperature of 100 deg F for 12 hours or 70 deg F for 16 hours.
  2. Keep units damp and continue curing to comply with one of the following:
    - a. No fewer than five days at mean daily temperature of 70 deg F or above.
    - b. No fewer than six days at mean daily temperature of 60 deg F or above.
    - c. No fewer than seven days at mean daily temperature of 50 deg F or above.
    - d. No fewer than eight days at mean daily temperature of 45 deg F or above.
- F. Acid etch units after curing to remove cement film from surfaces to be exposed to view.
- G. Colors and Textures: Match Architect's samples.

## 2.3 MORTAR MATERIALS

- A. Provide mortar materials that comply with Division 04 Section "Unit Masonry."

## 2.4 ACCESSORIES

- A. Anchors: Type and size indicated, fabricated from steel complying with ASTM A 36/A 36M, and hot-dip galvanized to comply with ASTM A 123/A 123M.

- B. Dowels: 1/2-inch- diameter, round bars, fabricated from steel complying with ASTM A 36/A 36M, and hot-dip galvanized to comply with ASTM A 123/A 123M.

## 2.5 MORTAR MIXES

- A. Comply with requirements in Division 04 Section "Unit Masonry" for mortar mixes.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
  - 1. Proceeding with installation constitutes acceptance and suitability of substrates and conditions.

### 3.2 SETTING CAST STONE IN MORTAR

- A. Install cast stone units to comply with requirements in Division 04 Section "Unit Masonry."
- B. Set cast stone as indicated on Drawings. Set units accurately in locations indicated with edges and faces aligned according to established relationships and indicated tolerances.
  - 1. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place.
  - 2. Coordinate installation of cast stone with installation of flashing specified in other Sections.
- C. Wet joint surfaces thoroughly before applying mortar or setting in mortar.
- D. Set units in full bed of mortar with full head joints unless otherwise indicated.
  - 1. Set units with joints 1/4 to 3/8 inch wide unless otherwise indicated.
  - 2. Build anchors and ties into mortar joints as units are set.
  - 3. Fill dowel holes and anchor slots with mortar.
  - 4. Fill collar joints solid as units are set.
  - 5. Build concealed flashing into mortar joints as units are set.
  - 6. Keep joints at shelf angles open to receive sealant.
- E. Tool exposed joints slightly concave when thumb print hard, using a jointer larger than joint thickness unless otherwise indicated.
- F. Provide sealant joints at copings and other horizontal surfaces, at expansion, control, and pressure-relieving joints, and at locations indicated.
  - 1. Keep joints free of mortar and other rigid materials.
  - 2. Build in compressible foam-plastic joint fillers where indicated.
  - 3. Form joint of width indicated, but not less than 3/8 inch.
  - 4. Prime cast stone surfaces to receive sealant and install compressible backer rod in joints before applying sealant unless otherwise indicated.

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5. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Division 07 Section "Joint Sealants."

### 3.3 INSTALLATION TOLERANCES

- A. Comply with requirements of Division 04 Section "Unit Masonry."

### 3.4 ADJUSTING AND CLEANING

- A. Comply with requirements of Division 04 Section "Unit Masonry."
- B. Remove and replace stained and otherwise damaged units and units not matching approved Samples. Cast stone may be repaired if methods and results are approved by Architect.
- C. Replace units in a manner that results in cast stone matching approved Samples, complying with other requirements, and showing no evidence of replacement.

END OF SECTION 047200

SECTION 05 1200 - STRUCTURAL STEEL

PART 1 GENERAL

1.01 SUMMARY

- A. Related Documents: General and Supplementary Conditions of the Contract, Division 1 - General Requirements, and Drawings are applicable to this Section.
- B. Section Includes:
  - 1. Labor, materials, services, and equipment required in conjunction with or incidental to the furnishing, fabrication, delivery, and erection of structural steel complete, including, but not limited to, the following
    - a. Structural steel columns, girders, beams, angles, shelf angles, angle frames for openings in floors and roofs, steel plates, miscellaneous deck support angles, shop welded shear studs, connections and component parts.
    - b. Qualification of welders.
    - c. Grouting under base plates.
    - d. Shop prime coat of paint and field touch-up painting.
    - e. Temporary construction bracing.
  - 2. The extent of structural steel work is shown on the drawings, including schedules, notes and details to show sizes and locations of members, typical connections and types of steel required.
  - 3. Include supplementary parts and members necessary to complete the structural steel work, regardless of whether such parts are definitely shown or specified, and furnish such bolts, gussets, plates, and other fasteners and accessories as may be required for proper assembly of items. Include miscellaneous deck support angles as required for proper support of metal floor deck around columns, gussets, openings, and obstructions.

1.02 QUALITY ASSURANCE

- A. Testing and Laboratory Services
  - 1. Testing laboratory services for quality control: Refer to Section 01400.
- B. Codes and Standards: Comply with provisions of following, except as otherwise indicated
  - 1. AISC "Code of Standard Practice for Steel Buildings and Bridges.
  - 2. AISC "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings," including the "Commentary" and Supplements thereto as issued.
  - 3. AISC "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts" approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation.
  - 4. AWS D1.1 "Structural Welding Code.
  - 5. Industrial Fasteners Institute "Handbook on Bolt, Nut, and Rivet Standards.
  - 6. Steel Structure Painting Council
    - a. Painting Manual, Volume 1, Good Painting Practice.
    - b. Painting Manual, Volume 2, Systems Specifications.
  - 7. Research Council on Riveted and Bolted Structural Joints: "Specifications for Structural Joints using ASTM A 325 or A490 Bolts.
- C. Design
  - 1. Connections: Design connections under direct supervision of a Professional Engineer registered in the State of Texas, to resist forces shown on structural drawings and as required by building code. Indicate forces, in detail, on shop drawings. Design connections in accordance with requirements shown on drawings. Provide full penetration welds for moment connections to develop full strength of beam. Use design values for high strength bearing type bolts with thread allowed across shear plane.

2. Substitutions:
  - a. Submit substitutions of sections or modifications of details, or both, and reasons with shop drawings for approval.
  - b. Clearly identify and note substitutions as such.
  - c. Coordinate approved substitutions, modifications, and necessary changes in related portions of work by fabricator and accomplish same at no additional cost to Owner.
3. Responsibility for Errors: Fabricator is responsible for errors of detailing, fabrications, and for correct fitting of structural steel members.
4. Templates: Furnished by Fabricator with instructions for setting of anchor bolts and bearing plates.

### 1.03 QUALIFICATIONS

- A. Structural Steel Fabricator: Not less than 10 years experience in fabrication of structural steel for buildings.
- B. Structural Steel Erection: Not less than 5 years experience in erection of structural steel.
- C. Welders: Qualified to perform procedures and positions encountered per AWS certification standards.

### 1.04 SUBMITTALS

- A. Product Data: Submit producer's or manufacturer's Specifications and installation instructions for following products. Include laboratory test reports and other data to show compliance with Specifications, including specified standards.
  1. Structural steel, each type, including certified copies of mill reports covering chemical and physical properties.
  2. High strength bolts, each type, including nuts and washers.
  3. Structural steel primer paint.
  4. Shear studs.
- B. Shop Drawings
  1. Submit Shop Drawings including design calculations of registered professional engineer, and including complete details and schedules for fabrication and shop assembly of members, and details, schedules, procedures, and diagrams showing sequence of erection. Do not use reproducibles of Contract Documents for shop drawings.
  2. Submit 1 sepia transparency and blue line prints as required by Section 01300 of each detailed Shop and Installation Drawing including design calculations for connections of structural steel. Design calculations will be retained for the Architect/Engineer's file, and will not be returned approved. Architect/Engineer's review shall cover member sizes, general locations, spacings, and details of design. Omission from shop drawings of any materials required by the Contract Documents shall not relieve the Contractor of the responsibility of furnishing and installing such materials, even though such Shop Drawings may have been returned and reviewed.
  3. Include details of cuts, connections, camber, holes, and other pertinent data. Indicate welds by standard AWS symbols, and show size, length, and type of each weld.
  4. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed by other trades.
- C. Certificates and Reports
  1. Welders' Certificates: Submit Manufacturer's Certificates, certifying welders employed on the work, verifying AWS qualifications within the previous 12 months.

### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store materials in accordance with requirements of Section 01600.
- B. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete or masonry, in ample time to not delay that work.

- C. Store materials to permit easy access for inspection and identification. Keep steel members off ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration.
- D. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

#### 1.06 JOB CONDITIONS

- A. Coordinate erection of structural steel with work of other trades.
- B. Do not install columns which have anchor bolts in concrete, until concrete members have attained their 28 day compressive strengths.

### PART 2 PRODUCTS

#### 2.01 MATERIALS

- A. Metal Surfaces, General: For fabrication of work which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names, and roughness. Remove blemishes by grinding, or by welding and grinding, prior to cleaning, treating and application of surface finishes.
- B. Steel
  - 1. Wide Flange Structural Shapes: ASTM A 570 Grade 50
  - 2. All other Structural Steel Shapes, Plates, and Bars: ASTM A 36,
  - 3. Cold-Formed Steel Tubing: ASTM A 500, Grade B, (46,000 psi yield).
  - 4. Steel Pipe: ASTM A 53, Type E or S, Grade B.
  - 5. HSS Round Shapes: ASTM A 500 Gr. B (42,000 psi yield).
  - 6. HSS Rectangular Shapes: ASTM A500 Gr. B (46,000 psi yield).
- C. Bolts and Washers
  - 1. Anchor Bolts and Erection Bolts: Conform to ASTM A 307 and to requirements for regular hexagon bolts and nuts of ANSI Standards B18.2.1 and B18.2.2.
  - 2. High Strength Bolts for Connections: Conform to ASTM A 325 or A490.
    - a. Dimensions of Bolt Heads or Nuts: Conform to requirements for heavy hexagon nuts of ANSI Standard B18.2.2.
  - 3. Standard Washers: Flat and smooth, conforming to requirements of Type A in ANSI Standard B23.1.
    - a. Beveled Washers for `S' Shapes and Channels: Square or rectangular, taper in thickness, and be smooth.
    - b. Provide hardened steel washers for use with high strength bolts.
  - 4. At Contractor option, direct tension indicating washers for high strength bolts may be used on connections except anchor and erection bolts.
    - a. Acceptable Manufacturer Load Indicator Washers: Bethlehem Steel Corp.
  - 5. At the Contractor's option, tension control bolts may, be used in lieu of standard high strength bolts and load indicating washers.
    - a. Acceptable Manufacturer: LeJeune Bolt Company.
  - 6. Drilled Anchor Bolts:
    - a. Acceptable Product: "Wej-It" Bolts by Wej- It Corp., Broomfield, CO.
- D. Welding Electrodes: Conform to Specifications of the American Welding Society. Use E70 electrodes for ASTM A 36 Steel. For high-strength, low alloy steel, use electrodes, and filler metals equal in strength and compatible in appearance to parent metals being joined.
- E. Primer Paint: FS TT-P-31, red oxide, 3 mils DFT.



- F. Zinc-Coating: Provide on items exposed to elements and on masonry shelf angles, conforming to ASTM Specification A 123.
  - 1. Zinc-coating for Threaded Products: Conform to ASTM A 153, Class C.
  - 2. Zinc-coating for Sheet Steel: Conform to ASTM A 591.
- G. Cold Galvanizing Compound (touch-up):
  - 1. Acceptable Product: ZRC Cold Galvanizing Compound by ZRC Chemical Products, Quincy, MA.
- H. Grout
  - 1. Metallic Shrinkage - Resistant grout, pre-mixed, factory - packaged ferrous aggregate grouting compound.
    - a. Acceptable Products:
      - 1) Firmix by Euclid Chemical Co.
      - 2) Ferrolith G by Sonneborn/Contech.
      - 3) Kemox C by Sika Chemical.
  - 2. Non-metallic shrinkage-resistant grout, pre-mixed, non-metallic, non-corrosive, non-staining product containing selected silica sands, portland cement, shrinkage compensating agents, plasticizing and water reducing agents.
    - a. Acceptable Products:
      - 1) Euco N.S. by Euclid Chemical Co.
      - 2) Crystex by L&M Construction Chemicals.
      - 3) Masterflow 713 by Masterbuilders.

## 2.02 FABRICATION

- A. Shop Fabrication and Assembly
  - 1. Fabricate and assemble structural assemblies in shop to greatest extent possible. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on final Shop Drawings. Provide camber in structural members where indicated.
    - a. Specified Camber Tolerance (provide the following unless indicated otherwise on Drawings)
      - 1) Minus 0 to plus 1/2 inch for members up to 50 feet long.
      - 2) Additional 1/8 inch for each 10 feet of length over 50 feet long.
  - 2. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.
  - 3. Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs, and other defects.
  - 4. Splicing of structural steel members is prohibited without prior approval of Architect/Engineer. Any member having a splice not shown and detailed on approved Shop Drawings shall be rejected.
  - 5. Plates: Free of gross internal discontinuities such as ruptures and delaminations.
- B. Connections: Weld or bolt shop connections, as indicated.
  - 1. Bolt field connections, except where welded connections or other connections are indicated. Provide specified threaded fasteners for principle bolted connections. Drill or punch holes for bolted constructions at right angles to member. The slope of surfaces under the bolt head and nut shall not exceed 1:20. Provide beveled washers where slopes exceed 1:20. Bolt holes shall have a diameter not greater than one-sixteenth (1/16) inch larger than the nominal bolt diameter. Do not flame cut holes or enlarge by burning.
  - 2. High strength bolted connections: Install in accordance with AISC "Specifications for Structural Joints using ASTM A 325 Bolts" (RCRBSJ).
  - 3. Welded Construction: Comply with AWS Code for procedures, appearance and quality of welds, and methods used in correcting welding work. Assemble and weld built-up sections by methods which will produce true alignment of axis without warp. Welds not specified shall be

continuous fillet welds, using minimum fillet designed to develop the full strength of the membrane. No combination of bolts and welds shall be used for stress transmission at the same face of any connections.

4. Clean areas to which studs are to be attached of rust, oil, grease, and paint. When the mill scale is sufficiently thick to cause difficulty in obtaining proper welds, remove by grinding or sand-blasting.
  5. For high-strength, low-alloy steels, follow welding procedures as recommended by steel producer for exposed and concealed connections.
  6. Base plates: Hole sizes for anchor bolts may be oversized to facilitate erection as follows:
    - a. Bolts 3/4 inch to 1 inch diameter - 5/16 inch oversize
    - b. Bolts 1 inch to 2 inch diameter - 1/2 inch oversize
    - c. Bolts over 2 inch diameter - 1 inch oversize
    - d. Use oversize or plate washers under nut at all oversized holes in base plates. Washers must be large enough to cover the entire hole. Washer thickness shall be at least one-eighth of bolt diameter.
- C. Holes for Other Work: Provide holes required for securing other work to structural steel framing, and for passage of other work through steel framing members, as shown on final Shop Drawings. Provide threaded nuts welded to framing, and other specialty items as indicated to receive other work. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning. Drill holes in bearing plates.

### 2.03 FINISH

- A. General: Shop paint with one coat of specified primer structural steel, except those members or portions of members described below.
- B. Paint embedded steel which is partially exposed on exposed portions and initial 2 inches of embedded areas only.
- C. Do not paint top face of beams which support metal floor deck.
- D. Do not paint members exposed to the elements. These are to be hot-dipped galvanized as specified herein.
- E. Do not paint surfaces which are to be welded.
- F. Do not paint surfaces which are to receive sprayed on fireproofing, or are encased in concrete.
- G. Surface Preparation: After inspection and before shipping, clean steel-work to be painted. Remove loose rust, loose mill scale, and spatter, slag or flux deposits. Clean steel in accordance with Steel Structures Painting Council (SSPC) as follows
  1. SP-1 "Solvent Cleaning."
  2. SP-2 "Hand Tool Cleaning."
  3. SP-3 "Power Tool Cleaning."
  4. SP-7 "Brush-off Blast Cleaning."
- H. Painting: Immediately after surface preparation, apply structural steel primer paint in accordance with manufacturer's instructions and at a rate to provide a uniform dry film thickness of 2.5 mils. Use painting methods which result in full coverage of joints, corners, edges, and exposed surfaces.
- I. Galvanize structural steel members to ASTM A 123. Galvanize all members which will be exposed to the elements, and elsewhere as detailed.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

- B. Beginning of installation means erector accepts existing conditions.

### 3.02 PREPARATION

- A. Examine areas and conditions under which structural steel work is to be installed, and notify Architect/Engineer of conditions detrimental to proper and timely completion of work.
- B. Check elevations of concrete and masonry bearing surfaces and locations of anchor bolts and similar devices before erection proceeds.

### 3.03 ERECTION

- A. General: Comply with AISC Specifications and Code of Standard Practice, and as herein specified.
- B. Employ registered Professional Engineer or land surveyor for accurate alignment and elevation of structural steel.
- C. Temporary Shoring and Bracing:
  - 1. Provide adequate shoring and bracing to safely withstand all loads to which the structure may be subjected during the construction process, including wind loads, dead loads, construction, material, and equipment loads. Such bracing shall remain in place as long as required for safety.
  - 2. As the erection progresses, make permanent welded or bolted connections sufficiently to withstand erection stresses and maintain stability.
  - 3. The design of temporary shoring and bracing shall be the responsibility of the Contractor.
- D. Temporary Planking: Provide temporary planking and working platforms as necessary to effectively complete the work.
- E. Anchor Bolts: Furnish anchor bolts and other connectors required for securing structural steel to foundations and other in-place work. Furnish templates and other devices as necessary for presetting bolts and other anchors to accurate locations.
- F. Setting Bases and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of base and bearing plates.
  - 1. Set loose and attached base plates and bearing plates for structural members on wedges or other adjusting devices.
  - 2. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with edge or base or bearing plate prior to packing with grout.
  - 3. Pack grout solidly between bearing surfaces and bases or plates to insure that no voids remain. Pack from one side only, with dams on other sides to pack against. Finish exposed surfaces, protect installed materials, and allow to cure. For proprietary grout materials, comply with manufacturer's instructions. Grout under base plates immediately after erecting the member and before additional load is placed on the member. Refer to Section 03600 for additional information.
- G. Field Assembly:
  - 1. Set structural frames accurately to lines and elevations indicated. Align and adjust various members forming a part of a complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces which will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
  - 2. Level and plumb individual members of structure within specified AISC tolerances.
  - 3. Erection tolerances: Individual pieces shall be erected so that deviation from plumb, level, and alignment shall not exceed 1 to 500.
  - 4. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for the difference between temperature at time of erection and mean temperature at which the structure will be when completed and in service.

5. Splice members only where indicated and accepted on final shop drawings.
  6. Where parts cannot be assembled or fitted properly as a result of errors in fabrication or of deformation due to handling or transportation, report conditions immediately to the Architect/Engineer along with proposed method of correction. The straightening of bends or warps shall be done by approved methods. Bent or damaged heat-treated parts will be rejected.
  7. Fasten splices in compression members after the abutting surfaces have been brought completely into contact.
- H. Erection Bolts: On exposed welded construction, remove erection bolts, fill holes with plug welds and grind smooth at exposed surfaces. On non-exposed welded construction, tighten erection bolts securely and leave in place or if removed, fill holes with plug welds.
- I. Bolted Connections
1. High strength bolts shall be installed in conformance with the "Specification for Structural Joints using ASTM A 325 or A 490 Bolts".
  2. ASTM A 307 bolts shall be tightened using a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench, bringing the plies into snug contact.
  3. High strength bolts shall be tightened to provide at least the minimum tension shown in Table 4 of the "Specification for Structural Joints using ASTM A 325 and A 490 Bolts". Verification of tightening shall be done by direct tension indicators, or by properly calibrated wrenches. Do not re-use bolts where positive cinching of nut has been reversed at any time.
  4. Bolted parts shall fit solidly together when assembled. Joint surfaces shall be free of burrs, dirt and other foreign material that would prevent solid seating of the parts.
  5. Bolts tightened by calibrated wrench or by torque control shall have a hardened washer under the element (nut or bolt head) turned in tightening.
  6. Hardened washers shall be placed over slotted holes in an outer ply. Hardened beveled washers shall be used where the outer face of the bolted parts has a slope greater than 1:20 with respect to the bolt axis.
- J. Comply with AISC recommendations for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
- K. Do not enlarge holes in members by burning or by use of drift pins, except in secondary bracing members. Ream holes that must be enlarged to admit bolts.
- L. Gas Cutting: Do not use gas cutting torches in field for correcting fabrication errors in structural framing. Cutting will be permitted only on secondary members which are not under stress, as acceptable to Architect/Engineer. Finish gas-cut sections equal to a sheared appearance when permitted.
- M. Touch-up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas with same materials as used for shop painting. Apply by brush or spray to provide a minimum dry film of thickness of 2.5 mils.

### 3.04 FIELD QUALITY CONTROL

- A. Fabrication of, erection of, and connections between, structural steel members, including welding and tension in high strength bolts, will be accomplished under and subject to the inspection and approval of an independent testing agency. The structural steel fabricator and erector shall afford full cooperation to the laboratory.
- B. Perform the following testing and inspection: (Prior to placement of steel deck)
1. Check temporary bracing of steel frame.
  2. Check location of condition of anchor bolts.
  3. Check plumbness and tolerance of steel frame.
  4. Visually inspect common bolts.
  5. Inspection of high-strength bolting

- a. Visually inspect connections.
  - b. Check tightness of at least 33 percent of connections.
  - c. Check at least two bolts of each girder to column connection.
  6. Visually inspect field and shop welds.
  7. Ultrasonic or X-ray testing of full penetration welds.
  8. Re-inspect corrective measures required at expense of Contractor.
  9. Verify that no members are damaged.
  10. Certify that materials and installation are according to Contract Documents and industry standards.
- C. Gas Cutting: Do not use gas cutting torches for correcting fabrication errors in the structural framing. Cutting will be permitted only on secondary members as acceptable to the Structural Engineer. Finish gas-cut sections equal to a sheared appearance when gas finish cutting is permitted. Do not flame cut holes or enlarge holes by burning.
- D. Correction: The fabricator or erector shall correct deficiencies in structural steel work which inspection and test reports have indicated to be not in compliance with the specified requirements. Perform all additional tests required to reconfirm non-compliance of the original work and to show compliance of corrected work.
- E. All welders employed during erection of structural steel must be certified for type of base materials and positions encountered. Certification testing to be performed at Contractor's expense.
- 3.05 PROTECTION
- A. Protect installed work as required to insure original integrity is not altered.
- 3.06 CLEAN-UP
- A. Clean steel as work progresses to remove foreign matter.

END OF SECTION

SECTION 05 3110 - STEEL ROOF DECK

PART 1 GENERAL

1.01 SUMMARY

- A. Related Documents: General and Supplementary Conditions of the Contract, Division 1 - General Requirements, and Drawings are applicable to this Section.
- B. Section Includes:
  - 1. Steel roof deck and accessories.
  - 2. Framed openings up to 18 inches.

1.02 QUALIFICATIONS

- A. Installer: Company specializing in performing the work of this Section with minimum 3 years documented experience.
- B. Design deck layout, spans, fastening, and joints under direct supervision of a Professional Structural engineer experienced in design of this work and licensed in the State of Texas.

1.03 SUBMITTALS

- A. Shop Drawings: Submit in accordance with Section 01300.
- B. Indicate materials, quantities, layout, location of openings and reinforcing, type and location of welds, and details of accessories and metal closure strips. Indicate welds by standard welding symbols adopted by the American Welding Society. Show diaphragm shear support and sidelap fasteners.
- C. Product Data: Span tables and material descriptions and recommended installation instructions.
- D. Performance Criteria and Tests
  - 1. Paint Humidity and Blister Resistance Primer coating shall have a #10 rating when subjected to 1000 hours, 5 percent solution salt spray test in accordance with ASTM B 117.
- E. Manufacturer's Installation Instructions: Indicate specific installation sequence and special instructions.

1.04 DESIGN CRITERIA

- A. Installed deck to withstand net uplift loading of 12 pounds per square foot.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Section 01600.
- B. Store decking under provisions of Section 01600 on wood sleepers with slope for positive drainage.
- C. Cut plastic wrap to encourage ventilation.

1.06 COORDINATION

- A. Coordinate installation with structural steel erection. Do not proceed until structure is ready to receive metal decking.

1.07 FIELD MEASUREMENTS

- A. Verify that field measurements are as shown on Drawings.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements herein, provide products from one of the following:
  - 1. Vulcraft.
  - 2. Epic Metals.
  - 3. Wheeling Corrugating Co.
- B. Substitutions: Under provisions of Section 01600.

### 2.02 MATERIALS

- A. Sheet Steel: ASTM A 611, Grade C, prime painted.
- B. Bearing Angles: ASTM A 36 steel.
- C. Welding Materials: AWS D1.1 and D1.3.
- D. Metal Closure Strips, Wet Concrete Stops, Cover Plates, and Related Accessories: 22 gage sheet steel; of required profiles and size.
- E. Primer: Grey oxide type.
- F. Touch-up Primer: Zinc chromate type.

### 2.03 FABRICATION

- A. Metal Decking: Minimum 20 gage sheet steel, 1-1/2 inch high, fluted profile to SDI IR 36 inch sheets; multiple span; lapped joints, continuous over 3 or more spans.
- B. Fabricate metal decking in accordance with SDI Design Manual for Composite Decks, Form Decks, Roof Decks to accommodate maximum working stress of 20,000 psi and maximum span deflection of L/240.
- C. Fabricate roof sump pan of 14 gage sheet steel, flat bottom, sloped sides, recessed 1-1/2 inches below roof deck surface, bearing flange 3 inches wide, watertight.

### 2.04 ACCESSORIES

- A. Flute Closures: Closed cell foam rubber, 1 inch thick; profiled to fit tight to the decking.
- B. Fasteners: Galvanized hardened steel, self-tapping
- C. Weld Washers: Mild steel, uncoated, 3/4 inch outside diameter, 1/8 inch thick.

## PART 3 EXECUTION

### 3.01 INSPECTION

- A. Check supporting members for correct layout and alignment.
- B. Verify that surfaces to receive deck are free from debris.
- C. Do not proceed with installation until defects are corrected.
- D. Beginning of installation indicates acceptance of existing conditions.

### 3.02 INSTALLATION

- A. Erect metal decking in accordance with SDI Design Manual for Composite Decks, Form Decks, and Roof Decks. Provide welding in accordance with AWS D1.1 and D1.3.

- B. On steel support members provide 3 inch minimum bearing and overlap ends of deck minimum 2 inches. Align and level on supports.
- C. Fasten male/female side lap as indicated with self tapping #10 screws.
- D. Fasten deck to steel support members at ends and intermediate supports as indicated with 5/8 inch diameter puddle welds at ends of units.
- E. Reinforce deck openings up to 18 inches in size with 3 by 3 by 1/4 inch steel angles. Span frame over adjacent joists. Place angles perpendicular to flutes; extend minimum two flutes each side of opening and weld to deck.
- F. Install 6 inch wide sheet steel cover plates where deck changes direction. Spot weld in place 12 inches oc maximum.
- G. Install sheet steel closures and angle flashings to close openings between deck and walls, columns, and openings.
- H. Install foam cell closures in locations above walls and partitions or as indicated.
- I. Immediately after welding deck in place, touch-up welds, burned areas, and surface coating damage with prime paint.
- J. Run deck and insulation under mechanical units so that the only penetration is for ductwork. Shim mechanical unit curbs with steel channels supported directly by joists, to make units level. Refer to drawing details.

### 3.03 FIELD QUALITY CONTROL

- A. Field inspection will be performed under provisions of Section 01400.
- B. Qualification of Welders: Qualify the welding process and all welders, and periodically monitor the work in accordance with the requirements of AWS D1.3.

### 3.04 CLEANING

- A. Clean steel as work progresses to remove foreign matter.

END OF SECTION



## SECTION 05 4000 - COLD-FORMED METAL FRAMING

### PART 1 GENERAL

#### 1.01 SUMMARY

- A. Types of cold-formed metal framing units include the following:
  - 1. Load-bearing punched channel studs.
  - 2. C-shaped load-bearing steel studs.
  - 3. C-shaped steel joists
- B. Non-load bearing studs are specified in Section 09250, "Gypsum Drywall."

#### 1.02 SUBMITTALS

- A. Product Data: Submit product information and installation instructions from manufacturers for each item of cold-formed metal framing and accessories.
- B. Shop Drawings: Shop drawings shall include placing drawings for framing members showing size and gauge designations, number, type, location, and spacing.
  - 1. Indicate supplemental strapping, bracing, splices, bridging, accessories, and details required for proper installation.
- C. Welding Certificates: Provide certificate signed by Contractor certifying that welders comply with requirements specified under "Quality Assurance" Article, prior to performing work.
- D. Welding Procedures: Provide written welding procedure specification (WPS) document per AWS Code requirements.

#### 1.03 QUALITY ASSURANCE

- A. Component Design: Calculate structural properties of studs and joists in accordance with the American Iron and Steel Institute (AISI), "Specification for Design of Cold-Formed Steel Structural Members."
- B. Welding Standards: Comply with applicable provisions of ANSI/AWS D1.1 "Structural Welding Code-Steel", and ANSI/AWS D1.3 "Structural Welding Code-Sheet Steel."

Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved, and if pertinent, has undergone recertification.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

Deliver to project site in manufacturer's unopened containers or bundles, fully identified with name, brand, type, and grade. Store off the ground in a dry ventilated space or protect with impervious covering. Protect metal framing units from rusting and damage.

## PART 2 PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include but are not limited to the following:

Dale Industries, Inc.  
Dietrich Industries, Inc.  
USG Industries  
Unimast, Inc.  
Wheeling Corrugating Co.

### 2.02 METAL FRAMING

- A. System Components: Manufacturers' standard load-bearing steel studs and joists of type, size, shape, and gauge as indicated. With each type of metal framing required, provide manufacturer's standard steel runners (tracks), blocking, lintels, reinforcements, shoes, clip angles, fasteners, and accessories for applications indicated, as needed to provide a complete metal framing system.
- B. Materials and Finishes:
1. For 16 gauge and heavier units, fabricate metal framing components of structural quality steel sheet with a minimum yield point of 40,000 psi, ASTM A 446 Grade C.
  2. For 18 and 20 gauge units, fabricate metal framing components of commercial quality steel sheet with a minimum yield point of 33,000 psi, ASTM A 446 Grade A.
  3. Provide galvanized finish to metal framing components complying with ASTM A 525 for minimum G 60 coating.
  4. Finish of installation accessories to match that of main framing components, unless otherwise indicated.
- C. Fasteners: Provide nuts, bolts, washers, screws, and other fasteners with corrosion-resistant plated finish.
- D. Electrodes for Welding: Comply with AWS Code and as recommended by stud manufacturer.
- E. Galvanizing Repair: Where galvanized surfaces are damaged, prepare surfaces and repair in accordance with procedures specified in ASTM A 780.

### 2.03 FABRICATION

- A. General: Framing components may be prefabricated into assemblies before erection. Fabricate panels plumb, square, true-to-line, and braced against racking with joints welded. Perform lifting of prefabricated units to prevent damage or distortion.
1. Fabricate units in jig templates to hold members in proper alignment and position and to assure consistent component placement.
- B. Fasten cold-formed metal framing members by welding or screw fastening, as standard with fabricator. Do not field weld units of 20 gauge or lighter. Wire tying of framing members is not permitted.

1. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting weld work.
  2. Locate mechanical fasteners and install according to cold-formed metal framing manufacturer's instructions.
- C. Fabrication Tolerances: Fabricate units to a maximum allowable tolerance variation from plumb, level, and true-to-line of 1/8 inch in 10 feet.

## PART 3 PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. General: Install cold-formed metal framing and accessories plumb, square, true to line, and with connections securely fastened, in accordance with manufacturer's recommendations and the requirements of this Section.
1. Fasten cold-formed metal framing members by welding or screw fastening, as standard with fabricator. Wire tying of framing members is not permitted.
  2. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting weld work.
    - a. Where weld throat is not shown on the Contract documents, the weld throat shall be at least as large as the thickness of the thinnest sheet joined. All welds shall provide complete fusion of the sheets without "blow-out."
  3. Locate mechanical fasteners and install according to cold-formed metal framing manufacturer's instructions.
- B. Runner Tracks: Install continuous tracks sized to match studs. Align tracks accurately to layout at base and tops of studs.
1. Secure tracks as recommended by stud manufacturer for type of construction involved, spacing not to exceed 24 inches o.c. for nail or power-driven fasteners, or 16 inches o.c. for other types of attachment. Provide fasteners at corners and ends of tracks.
  2. All track butt joints, abutting pieces of track shall be securely anchored to a common structural element or they shall be spliced together.
- C. Wall Studs: Secure studs to top and bottom runner tracks, except where provisions for structure vertical movement is provided on drawings, by either welding or screw fastening at both inside and outside flanges.
1. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar requirements.
  2. Where stud system abuts structural columns or walls, including masonry walls, anchor ends of stiffeners to supporting structure.
  3. Axially loaded studs shall have full bearing against the inside web of top and bottom tracks. Splices in axially loaded studs are not permitted.

- D. Install supplementary framing, blocking, and bracing in metal framing system wherever walls or partitions are indicated to support fixtures, equipment, services, casework, heavy trim and furnishings, and similar work requiring attachment to the wall or partition. Where type of supplementary support is not otherwise indicated, comply with stud manufacturer's recommendations.
- E. Frame wall openings larger than 2'-0" square with double stud at each jamb of frame, except where more than two studs are either shown or indicated in manufacturer's instructions.
  - 1. Install runner tracks and jack studs above door openings, and above and below wall openings.
  - 2. Anchor tracks to jamb studs with stud shoes or by welding, and space jack studs same as full-height studs of wall.
  - 3. Secure stud system wall opening frame in manner indicated.
- F. Frame both sides of expansion and control joints with separate studs; do not bridge the joint with components of stud system.
- G. Install horizontal bridging in all load-bearing and exterior stud wall systems, with two (2) equally spaced rows for walls less than 10 feet high and rows spaced not more than 48 inches o.c. at walls higher than 10 feet.
- H. Horizontal Bridging is not required for non-loadbearing interior stud walls unless noted on the drawings.
- I. Provisions for structure vertical movement shall be provided where indicated on the drawings.
- J. All welds shall be touched up using zinc-rich paint.
- K. Erection Tolerances: Bolt or weld wall panels (at both horizontal and vertical junctures) to produce flush, even, true-to-line joints.
  - 1. Maximum variation in plane and true position between prefabricated assemblies should not exceed 1/16 inch.
- L. Installation of Joists: Install level, straight, and plumb, complete with bracing and reinforcing as indicated on drawings. Provide not less than 1-1/2 inch end bearing.
  - 1. Reinforce ends with end clips, steel hangers, steel angle clips, steel stud section, or as otherwise recommended by joist manufacturer.
  - 2. When required, reinforce joists at interior supports with single short length of joist section located directly over interior support, snap-on shoe, 30 percent side-piece lapped reinforcement, or other method recommended by joist manufacturer.
  - 3. Secure joists to interior support systems to prevent lateral movement of bottom flange.

END OF SECTION

## SECTION 055000 - METAL FABRICATIONS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Steel framing and supports for mechanical and electrical equipment.
  - 2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
  - 3. Metal bollards.
  - 4. Countertop support.
- B. Products furnished, but not installed, under this Section:
  - 1. Loose steel lintels.
  - 2. Anchor bolts and slotted-channel inserts indicated to be cast into concrete or built into unit masonry.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. 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; 180 deg F, material surfaces.

#### 1.3 SUBMITTALS

- A. Shop Drawings: Show fabrication and installation details for metal fabrications.
  - 1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

#### 1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

#### 1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

## 1.6 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 anchorages and steel weld plates and angles for casting into concrete. 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.

## PART 2 - PRODUCTS

### 2.1 METALS, GENERAL

- 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.

### 2.2 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40) unless otherwise indicated.
- C. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
  - 1. Size of Channels: 1-5/8 by 1-5/8 inches.
  - 2. Material Within Exterior Wall and Roof Construction: Galvanized steel, ASTM A 653/A 653M, structural steel, Grade 33, with G90 coating; 0.108-inch nominal thickness.
  - 3. Material for Interior Construction: Cold-rolled steel, ASTM A 1008/A 1008M, structural steel, Grade 33; 0.0966-inch minimum thickness; shop primed.

### 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.

## 2.4 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Shop Primers: Provide primers that comply with Division 09 painting Sections.
- C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- E. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

## 2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. 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 metals 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 bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. 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 so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
  1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1 -1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

## 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.
  1. Fabricate units from slotted channel framing where indicated.
  2. Furnish inserts for units installed after concrete is placed.
- C. Galvanize miscellaneous framing and supports in exterior wall and roof construction and where indicated.
- D. Prime miscellaneous interior framing and supports with primer specified in Division 09 Section "Painting" where indicated. Metal to be shop primed only.
- E.

## 2.7 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
  1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.
- C. Galvanize exterior miscellaneous steel trim.
- D. Prime interior miscellaneous steel trim with primer specified in Division 09 Section "Painting."

## 2.8 METAL BOLLARDS

- A. Fabricate metal bollards from Schedule 40 steel pipe.
- B. Galvanize steel bollards



## 2.9 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. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.
- B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span but not less than 8 inches unless otherwise indicated.
- C. Galvanize loose steel lintels located in exterior walls.

## 2.10 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.
- C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

## 2.11 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.
  - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- 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 Division 09 painting Sections.
- C. Preparation for Shop Priming: Prepare surfaces to comply with 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.
  - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with

edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

### 3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

### 3.3 INSTALLING METAL BOLLARDS

- A. Anchor bollards in concrete in formed or core-drilled holes not less than 8 inches deep and 3/4 inch larger than O D of bollard. Fill annular space around bollard solidly with nonshrink, nonmetallic grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward bollard.
- B. Fill bollards solidly with concrete, mounding top surface to shed water.

### 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.
  - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

NFCU'

- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055000

SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
  - 1. Wood blocking, cants, and nailers.
  - 2. Wood furring and grounds.
  - 3. Plywood backing panels.
- B. Related Sections include the following:
  - 1. Division 06 Section "Sheathing."
  - 2. Division 06 Section "Finish Carpentry" for nonstructural carpentry items exposed to view and not specified in another Section.

1.3 DEFINITIONS

- A. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.
- B. Lumber grading agencies, and the abbreviations used to reference them, include the following:
  - 1. SPIB: The Southern Pine Inspection Bureau.
  - 2. WCLIB: West Coast Lumber Inspection Bureau.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.
- B. Deliver interior wood materials that are to be exposed to view only after building is enclosed and weatherproof, wet work other than painting is dry, and HVAC system is operating and maintaining temperature and humidity at occupancy levels.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: D O C P S 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by

the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, omit grade stamp and provide certificates of grade compliance issued by grading agency.
3. Where nominal sizes are indicated, provide actual sizes required by D O C P S 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
4. Provide dressed lumber, S4S, unless otherwise indicated.

## 2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: A W P A C 2, except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to A W P A C 31 with inorganic boron (SBX).
  1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
  2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
  1. For exposed lumber indicated to receive a stained or natural finish, omit marking and provide certificates of treatment compliance issued by inspection agency.
- D. Application: Treat items indicated on Drawings, and the following:
  1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
  2. Wood sills, sleepers, blocking, furring, and similar concealed members in contact with masonry or concrete.
  3. Wood floor plates that are installed over concrete slabs-on-grade.

## 2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Comply with performance requirements in A W P A C 20 (lumber) and A W P A C 27 (plywood).
  1. Use treatment that does not promote corrosion of metal fasteners.
  2. Use Exterior type for exterior locations and where indicated.
  3. Use Interior Type A, High Temperature (HT) for enclosed roof framing, framing in attic spaces, and where indicated.
  4. Use Interior Type A, unless otherwise indicated.
- B. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.
- C. Application: Treat items indicated on Drawings, and the following:

1. Concealed blocking.
2. Roof construction.
3. Plywood backing panels.

#### 2.4 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
1. Blocking.
  2. Nailers.
  3. Cants.
  4. Furring.
  5. Grounds.
- B. For items of dimension lumber size, provide Construction or No. 2 grade lumber with 15 percent maximum moisture content and the following species:
1. Mixed southern pine; SPIB.
- C. For concealed boards, provide lumber with 15 percent maximum moisture content and the following species and grades:
- D. For blocking not used for attachment of other construction Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- F. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

#### 2.5 PLYWOOD BACKING PANELS

- A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exterior, AC in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

#### 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. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.

- E. Screws for Fastening to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
- F. Lag Bolts: ASME B18.2.1.
- G. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.
- H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
  - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
  - 2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION, GENERAL

- A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit 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 "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- C. Do not splice structural members between supports, unless otherwise indicated.
- D. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
  - 1. Provide metal clips for fastening gypsum board at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.
- E. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- F. Comply with AWWA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
  - 1. Use inorganic boron for items that are continuously protected from liquid water.
  - 2. Use copper naphthenate for items not continuously protected from liquid water.
- G. Securely attach 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.

- H. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; do not countersink nail heads, unless otherwise indicated.

### 3.2 WOOD BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.
- C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

### 3.3 WOOD FURRING INSTALLATION

- A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.
- B. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal- size furring horizontally at 24 inches o.c.

### 3.4 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, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061053



## SECTION 061600 - SHEATHING

### 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. Wall sheathing.
  - 2. Roof sheathing.
- B. Related Requirements:
  - 1. Division 06 Section "Miscellaneous Rough Carpentry" for plywood backing panels.
  - 2. Division 07 Section "Weather Barriers" for water-resistive barrier applied over wall sheathing.

#### 1.3 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.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

### PART 2 - PRODUCTS

#### 2.1 WOOD PANEL PRODUCTS, GENERAL

- A. Plywood: Either DOC PS 1 or DOC PS 2, unless otherwise indicated.

## 2.2 PRESERVATIVE-TREATED PLYWOOD

- A. Preservative Treatment by Pressure Process: AWWPA U1; Use category U C2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.
  - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Mark plywood with a appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
- C. Application: Treat all plywood, unless otherwise indicated.

## 2.3 WALL SHEATHING

- A. Plywood Wall Sheathing: Exposure 1 sheathing.
  - 1. Nominal Thickness: Refer to drawings.
- B. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.
  - 1. Product: Subject to compliance with requirements, provide "Dens-Glass Gold" by G-P Gypsum Corporation.
  - 2. Type and Thickness: Regular, 1/2 inch thick.
  - 3. Size: 48 by 96 inches for horizontal installation.

## 2.4 ROOF SHEATHING

- A. Plywood Roof Sheathing: Exposure 1 sheathing.
  - 1. Nominal Thickness: As indicated.

## 2.5 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 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing board to be attached,

with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

1. For steel framing less than 0.0329 inch thick, attach sheathing to comply with ASTM C 1002.
2. For steel framing from 0.033 to 0.112 inch thick, attach sheathing to comply with ASTM C 954.

## 2.6 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

- A. 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.
- B. 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 board and with a history of successful in-service use.

## 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.
- B. Cut panels around penetrations, eaves, 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.
- D. Coordinate wall and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- F. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

### 3.2 GYPSUM SHEATHING INSTALLATION

- A. Comply with GA-253 and with manufacturer's written instructions.

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1. Fasten gypsum sheathing to cold-formed metal framing with screws.
  2. Install boards with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
  3. Install boards with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- B. Apply fasteners so heads bear tightly against face of sheathing boards but do not cut into facing.
- C. Horizontal Installation: Abut ends of boards over centers of studs, and stagger end joints of adjacent boards not less than one stud spacing. Attach boards at perimeter and within field of board to each steel stud.
1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of boards.

### 3.3 SHEATHING JOINT-AND-PENETRATION TREATMENT

- A. Seal sheathing joints according to sheathing manufacturer's written instructions.

END OF SECTION 061600

## SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

### 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. Plastic-laminate and wood veneer cabinets.
2. Plastic-laminate countertops.
3. Solid-surfacing-material countertops.
4. Shop finishing of interior woodwork.

- B. Related Sections include the following:

1. Division 06 Section "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.

#### 1.3 DEFINITIONS

- A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated, including cabinet hardware and accessories and finishing materials and processes.

- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show details full size.
2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
3. Show locations and sizes of cutouts and holes for plumbing fixtures and other items installed in architectural woodwork.

- C. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

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- D. Submit 4 copies of shop drawings to Architect for review and 1 copy of shop drawings to Owner for concurrent review as outlined in Section 013300- "Submittal Procedures".

### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of woodwork.
- B. Quality Standard: Unless otherwise indicated, comply with Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

### 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork 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.
- B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
  - 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.

### 1.8 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.
- B. Wood veneer Species: Maple, plain sawn.

- C. Wood Products: Comply with the following:
  - 1. Hardboard: AHA A135.4.
  - 2. Medium-Density Fiberboard: ANSI A208.2, Grade MD.
  - 3. Particleboard: ANSI A208.1, Grade M-2.
  - 4. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.
  
- D. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.
  - 1. Manufacturers: Subject to compliance with requirements, manufacturers offering high-pressure decorative laminates as scheduled on drawings by one of the following:
    - a. Formica Corporation.
    - b. Nevamar Company, LLC; Decorative Products Div.
  
- E. Solid-Surfacing Material:

Quartz counter top material will be Owner furnished and Contractor fabricated and installed. Owner will coordinate delivery of material to the Millwork/Solid Surface subcontractor. Contractor shall manage and coordinate the fabrication and installation of Solid Surface counter tops. Contractor shall also warranty the fabrication and installation of Solid Surface counter tops.

## 2.2 FIRE-RETARDANT-TREATED MATERIALS

- 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.
  - 1. Do not use treated materials that do not comply with requirements of referenced woodworking standard or that are warped, discolored, or otherwise defective.
  - 2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
  - 3. Identify fire-retardant-treated materials with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.
  
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Comply with performance requirements of AWWA C20 (lumber) and AWWA C27 (plywood). Use the following treatment type:
  - 1. Exterior Type: Organic-resin-based formulation thermally set in wood by kiln drying.
  - 2. Interior Type A: Low-hygroscopic formulation.
  - 3. Kiln-dry materials before and after treatment to levels required for untreated materials.

## 2.3 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural woodwork.
- B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 135 degrees of opening, self-closing.
- C. Wire Pulls: Back mounted, brushed aluminum metal, 4 inches long, 5/16 inch in diameter. (Back House) and Mocket DP78D-2GM (Front of House)
- D. Catches: Magnetic catches, BHMA A156.9, B03141.
- E. Shelf Rests: BHMA A156.9, B04013; metal.
- F. Drawer Slides: BHMA A156.9, B05091.
  - 1. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Side mounted; full-over travel-extension type; zinc-plated steel ball-bearing slides.
  - 2. Box Drawer Slides: Grade 1HD-100; for drawers not more than 6 inches high and 24 inches wide.
  - 3. File Drawer Slides: Grade 1HD-200; for drawers more than 6 inches high or 24 inches wide.
  - 4. Pencil Drawer Slides: Grade 1; for drawers not more than 3 inches high and 24 inches wide.
- G. Door Locks: BHMA A156.11, E07121.
- H. Drawer Locks: BHMA A156.11, E07041.
- I. Grommets for Cable Passage through Countertops:
  - 1. As indicated on drawings.
- J. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
  - 1. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.
- K. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.
- L. Brushed Aluminum – Accents and Inlays.
- M. Work Station Bracket – 1/8" Steel (paint to match adjacent wall)

## 2.4 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.



- B. Furring, Blocking, Shims, and Hanging S Strips: Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content.
- C. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.
- D. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement, Contact cement.
  - 1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

## 2.5 FABRICATION, GENERAL

- A. Interior Woodwork Grade: Unless otherwise indicated, provide Custom-grade interior woodwork complying with referenced quality standard.
- B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- C. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- D. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
  - 1. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members 3/4 Inch Thick or Less: 1/16 inch.
- E. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- F. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cut outs to remove splinters and burrs.
  - 1. Seal edges of openings in countertops with a coat of varnish.
- G. Install glass to comply with applicable requirements in Division 08 Section "Glazing" and in GANA's "Glazing Manual." For glass in wood frames, secure glass with removable stops.

## 2.6 WOOD VENEER CABINETS

- A. Grade: Premium

- B. AWI Type of Cabinet Construction: Flush overlay.
- C. Wood Species and Cut for Exposed Surfaces: Maple, plain sawn or sliced.
  - 1. Matching of Veneer Leaves: Book match.
  - 2. Vertical Matching of Veneer Leaves: End match.
- D. Semiexposed Surfaces: Provide surface materials indicated below:
  - 1. Surfaces Other Than Drawer Bodies: Same species and cut indicated for exposed surfaces.
  - 2. Drawer Sides and Backs: Solid-hardwood lumber.
  - 3. Drawer Bottoms: Hardwood plywood.
- E. Provide dust panels of 1/4-inch plywood or tempered hardboard above compartments and drawers, unless located directly under tops.

## 2.7 PLASTIC-LAMINATE CABINETS

- A. Grade: Premium
- B. AWI Type of Cabinet Construction: Flush overlay.
- C. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:
  - 1. Horizontal Surfaces Other Than Tops: Grade HGS .
  - 2. Vertical Surfaces: Grade VGS.
  - 3. Edges: Grade VGS.
- D. Materials for Semi exposed Surfaces:
  - 1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, Grade VGS.
  - 2. Drawer Sides and Backs: Solid-hardwood lumber.
  - 3. Drawer Bottoms: Hardwood plywood.
- E. 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 on drawings.
- F. Provide dust panels of 1/4-inch plywood or tempered hardboard above compartments and drawers, unless located directly under tops.

## 2.8 PLASTIC-LAMINATE COUNTERTOPS

- A. High-Pressure Decorative Laminate Grade: HGP.

- B. 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 on drawings.
- C. Edge Treatment: As indicated on drawings.
- D. Core Material at Sinks: Particleboard made with exterior glue.

## 2.9 SOLID-SURFACING-MATERIAL COUNTERTOPS

- A. Solid-Surfacing-Material Thickness:
  - 1. 1/2 inch at Corian
  - 2. 3/4 inch at Caesarstone
- B. Colors, Patterns, and Finishes: Provide materials and products that result in colors of solid-surfacing material complying with the following requirements:
  - 1. As indicated on drawings.
- C. Fabricate tops in one piece, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.
  - 1. Fabricate tops with shop-applied edges of materials and configuration indicated.
  - 2. Fabricate tops with shop-applied backsplashes at vanities and loose backsplashes for field application at all other locations.
- D. Install integral sink bowls in countertops in shop.
- E. Drill holes in countertops for plumbing fittings in shop.

## 2.10 SHOP FINISHING

- A. General: Finish architectural woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.
- B. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.
- C. Wood Veneer:
  - 1. As indicated on drawings.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.
- B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

### 3.2 INSTALLATION

- A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.
- B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.
- C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.
- D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.
- F. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- G. 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 sag, bow, or other variation from a straight line.
  - 2. Maintain veneer sequence matching of cabinets with transparent finish.
  - 3. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c. with No. 10 wafer-head screws sized for 1-inch penetration into wood framing, blocking, or hanging strips.
- H. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.

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1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
  2. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
  3. Secure backsplashes to walls with adhesive.
  4. Calk space between backsplash and wall with sealant specified in Division 07 Section "Joint Sealants."
- I. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.

### 3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 064023

SECTION 072100 - THERMAL 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. This Section includes the following:
  - 1. Perimeter insulation under slabs-on-grade.
  - 2. Concealed building insulation.
- B. Related Sections include the following:
  - 1. Division 04 Section "Unit Masonry" for insulation installed in cavity walls and masonry cells.
  - 2. Division 07 Section "Ethylene-Propylene-Diene-Monomer (EPDM) Roofing" for insulation specified as part of roofing construction.
  - 3. Division 09 Section "Gypsum Board" for installation in metal-framed assemblies of insulation specified by referencing this Section.
  - 4. Division 21 Section "Fire-Suppression Systems Insulation."
  - 5. Division 22 Section "Plumbing Insulation."
  - 6. Division 23 Section "HVAC Insulation."

1.3 DEFINITIONS

- A. Mineral-Fiber Insulation: Insulation composed of rock-wool fibers, slag-wool fibers, or glass fibers; produced in boards and blanket with latter formed into batts (flat-cut lengths) or rolls.

1.4 PERFORMANCE REQUIREMENTS

- A. Plenum Rating: Provide glass-fiber insulation where indicated in ceiling plenums whose test performance is rated as follows for use in plenums as determined by testing identical products per "Erosion Test" and "Mold Growth and Humidity Test" described in UL 181, or on comparable tests from another standard acceptable to authorities having jurisdiction.
  - 1. Erosion Test Results: Insulation shows no visible evidence of cracking, flaking, peeling, or delamination of interior surface of duct assembly, after testing for 4 hours at 2500-fpm air velocity.
  - 2. Mold Growth and Humidity Test Results: Insulation shows no evidence of mold growth, delamination, or other deterioration due to the effects of high humidity, after inoculation with *Chaetomium globosum* on all surfaces and storing for 60 days at 100 percent relative humidity in the dark.

1.5 SUBMITTALS

## NFCU

- A. Product Data: For each type of product indicated.

### 1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of building insulation through one source from a single manufacturer.
- B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
  - 1. Surface-Burning Characteristics: ASTM E 84.
  - 2. Fire-Resistance Ratings: ASTM E 119.
  - 3. Combustion Characteristics: ASTM E 136.

### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect plastic insulation as follows:
  - 1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
  - 2. Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
  - 3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

### 2.2 FOAM-PLASTIC BOARD INSULATION

- A. Extruded-Polystyrene Board Insulation: ASTM C 578, of type and density indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively:
  - 1. Manufacturers:
    - a. Dow Chemical Company.
  - 2. Type IV, 1.60 lb/cu. ft., unless otherwise indicated.

- B. Foil-Faced, Polyisocyanurate Board Insulation: ASTM C 1289, Type I, Class 1 or 2, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, based on tests performed on unfaced core on thicknesses up to 4 inches.

- 1. Manufacturers:

- a. Rmax, Inc.

### 2.3 GLASS-FIBER BLANKET INSULATION

- A. Manufacturers:

- 1. Owens Corning.

- B. Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type III (blankets with reflective membrane facing), Class A (membrane-faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier), faced with foil-scrim-kraft, vapor-retarder membrane on 1 face.

- C. Where glass-fiber blanket insulation is indicated by the following thicknesses, provide blankets in batt or roll form with thermal resistances indicated:

- 1. 3-5/8 inches thick with a thermal resistance of 11 deg F x h x sq. ft./Btu at 75 deg F.
- 2. 5-1/2 inches thick with a thermal resistance of 19 deg F x h x sq. ft./Btu at 75 deg F.

### 2.4 AUXILIARY INSULATING MATERIALS

- A. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by insulation manufacturers for sealing joints and penetrations in vapor-retarder facings.

- B. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and for other conditions affecting performance.

- 1. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean substrates of substances harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.

### 3.3 INSTALLATION, GENERAL



- A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.
- C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.
- E. For preformed insulating units, provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

#### 3.4 INSTALLATION OF UNDER-SLAB INSULATION

- A. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
- B. Protect top surface of horizontal insulation from damage during concrete work by applying protection course with joints butted.

#### 3.5 INSTALLATION OF GENERAL BUILDING INSULATION

- 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. Seal joints between foam-plastic insulation 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. Set vapor-retarder-faced units with vapor retarder to warm-in-winter side of construction, unless otherwise indicated.
  - 1. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.
- D. Install mineral-fiber insulation in cavities formed by framing members according to the following requirements:
  - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill cavity, 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 clearance of insulation around recessed lighting fixtures.
  - 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, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

NFCU

3.6 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

## SECTION 07 2500 - WEATHER BARRIERS

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Weather barrier membrane
- B. Seam Tape
- C. Flashing
- D. Fasteners

#### 1.2 REFERENCES

- A. ASTM International
  - 1. ASTM C920; Standard Specification for Elastomeric Joint Sealants
  - 2. ASTM C1193; Standard Guide for Use of Joint Sealants
  - 3. ASTM D882; Test Method for Tensile Properties of Thin Plastic Sheeting
  - 4. ASTM D1117; Standard Guide for Evaluating Non-woven Fabrics
  - 5. ASTM E84; Test Method for Surface Burning Characteristics of Building Materials
  - 6. ASTM E96; Test Method for Water Vapor Transmission of Materials
  - 7. ASTM E1677; Specification for Air Retarder Material or System for Framed Building Walls
  - 8. ASTM E2178; Test Method for Air Permeance of Building Materials
- B. AATCC – American Association of Textile Chemists and Colorists
  - 1. Test Method 127 Water Resistance: Hydrostatic Pressure Test

#### 1.3 SUBMITTALS

- A. Product Data: Submit manufacturer current technical literature for each component.
- B. Samples: Weather Barrier membrane, minimum 8-1/2 inches by 11 inch.
- C. Quality Assurance Submittals
  - 1. Manufacturer Instructions: Provide manufacturer's written installation instructions.

#### 1.4 QUALITY ASSURANCE

- A. Qualifications
  - 1. Installer shall have experience with installation of similar weather barrier assemblies under similar conditions.
  - 2. Installation shall be in accordance with manufacturer's installation guidelines and recommendations.
  - 3. Source Limitations: Provide weather barrier and accessory materials produced by single manufacturer.

#### 1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver weather barrier materials and components in manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Store weather barrier materials as recommended by system manufacturer.

#### 1.6 SCHEDULING

- A. Review requirements for sequencing of installation of weather barrier assembly with installation of windows, doors, louvers and flashings to provide a weather-tight barrier assembly.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURER

A. Basis-of-Design Product: The design for weather barrier systems is based on DuPont™ Tyvek® StuccoWrap®. Subject to compliance with requirements and performance characteristics, other weather barrier systems may be approved.

1. DuPont Building Innovations; 4417 Lancaster Pike, Chestnut Run Plaza 721, Wilmington, DE 19805; 1-800-44-TYVEK (8-9835); <http://construction.TYVEK.com>

### 2.2 MATERIALS

A. Basis of Design: Textured, spunbonded polyolefin, non-woven, non-perforated, weather barrier is based upon DuPont™ Tyvek® StuccoWrap® and related assembly components.

B. Performance Characteristics:

1. Air Penetration: 0.004 cfm/ft<sup>2</sup> at 75 Pa, when tested in accordance with ASTM E2178. Type I per ASTM E1677.
2. Water Vapor Transmission: 50 perms, when tested in accordance with ASTM E96, Method B.
3. Water Penetration Resistance: 210 cm when tested in accordance with AATCC Test Method 127.
4. Basis Weight: 2.1 oz/yd<sup>2</sup>, when tested in accordance with TAPPI Test Method T-410.
5. Air Resistance: 300 seconds, when tested in accordance with TAPPI Test Method T-460.
6. Tensile Strength: 30/30 lbs/in., when tested in accordance with ASTM D882, Method A.
7. Tear Resistance: 7/9 lbs, when tested in accordance with ASTM D1117.
8. Surface Burning Characteristics: Class A, when tested in accordance with ASTM E84. Flame Spread: 5, Smoke Developed: 25

### 2.3 ACCESSORIES

A. Seam Tape: 2 inch wide, DuPont™ Tyvek® Tape as manufactured by DuPont Building Innovations.

B. Fasteners:

1. For Steel Frame Construction: DuPont™ Tyvek® Wrap Cap Screws, as manufactured by DuPont Building Innovations: 1-5/8 inch rust resistant screw with 2-inch diameter plastic cap or manufacturer approved 1-1/4" or 2" metal gasketed washer.
2. For Masonry Construction: Masonry tap-con fasteners with Tyvek® Wrap Caps as manufactured by DuPont Building Innovations: 2-inch diameter plastic cap fastener.

C. Sealants

2. Provide sealants that comply with ASTM C920, elastomeric polymer sealant to maintain watertight conditions.
3. Products:
  - a. DuPont Weatherization Sealant
  - b. Sealants recommended by the weather barrier manufacturer.

D. Adhesive:

1. Provide adhesive recommended by weather barrier manufacturer.

E. Primer:

1. Provide flashing manufacturer recommended primer to assist in adhesion between substrate and flashing.

F. Flashing

1. DuPont™ FlexWrap™, as manufactured by DuPont Building Innovations: flexible membrane flashing

- materials for window openings and penetrations.
2. DuPont™ StraightFlash™, as manufactured by DuPont Building Innovations: straight flashing membrane materials for flashing windows and doors and sealing penetrations and masonry ties, etc.
  3. DuPont™ StraightFlash™ VF, as manufactured by DuPont Building Innovations: dual-sided, straight flashing membrane materials for brickmold and non-flanged windows and doors.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify substrate and surface conditions are in accordance with weather barrier manufacturer recommended tolerances prior to installation of weather barrier and accessories.

### 3.2 INSTALLATION – WEATHER BARRIER

- A. Install weather barrier over exterior face of exterior wall substrate in accordance with manufacturer recommendations.
- B. Start weather barrier installation at a building corner, leaving 6-12 inches of weather barrier extended beyond corner to overlap.
- C. Apply wrap with grooved surface pattern in vertical direction.
- D. Install weather barrier in a horizontal manner starting at the lower portion of the wall surface. Maintain weather barrier plumb and level
- E. Shingle weather barrier over back edge of weep screed. Seal weather barrier with sealant or tape to weep screed. Ensure weeps are not blocked.
- F. Subsequent layers shall overlap lower layers a minimum of 6 inches horizontally in a shingling manner.
- G. Window and Door Openings: Extend weather barrier completely over openings.
- H. Weather Barrier Attachment:
  1. Steel Frame Construction: Attach weather barrier to studs through exterior sheathing. Secure using weather barrier manufacturer recommended fasteners, space 12 -18 inches vertically on center along stud line, and 24 inch on center, maximum horizontally.
  2. Masonry Construction: Attach weather barrier to masonry. Secure using weather barrier manufacturer recommended fasteners, space 12 -18 inches vertically on center and 24 inches maximum horizontally. Weather barrier may be temporarily attached to masonry using recommended adhesive, placed in vertical strips spaced 24 inches on center, when coordinated on the project site.
- I. Apply 4 inch by 7 inch piece of DuPont™ StraightFlash™ to weather barrier membrane prior to the installation cladding anchors.

### 3.3 SEAMING

- A. Seal seams of weather barrier with seam tape at all vertical and horizontal overlapping seams.
- B. Seal any tears or cuts as recommended by weather barrier manufacturer.

### 3.4 OPENING PREPARATION (for use with non-flanged windows – all cladding types)

- A. Flush cut weather barrier at edge of sheathing around full perimeter of opening.
- B. Cut a head flap at 45-degree angle in the weather barrier at window head to expose 8 inches of sheathing. Temporarily secure weather barrier flap away from sheathing with tape.

### 3.5 FLASHING (for use with non-flanged windows – all cladding types)

- A. Cut 9-inch wide DuPont™ FlexWrap™ a minimum of 12 inches longer than width of sill rough opening.
- B. Cover horizontal sill by aligning DuPont™ FlexWrap™ edge with inside edge of sill. Adhere to rough opening across sill and up jambs a minimum of 6 inches. Secure flashing tightly into corners by working in

along the sill before adhering up the jambs.

- C. Fan DuPont™ FlexWrap™ at bottom corners onto face of wall. Firmly press in place. Mechanically fasten fanned edges.
- D. Apply 9-inch wide strips of DuPont™ StraightFlash™ at jambs. Align flashing with interior edge of jamb framing. Start DuPont™ StraightFlash™ at head of opening and lap sill flashing down to the sill.
- E. Spray-apply primer to top 6 inches of jambs and exposed sheathing.
- F. Install DuPont™ FlexWrap™ at opening head using same installation procedures used at sill. Overlap jamb flashing a minimum of 2 inches.
- G. Coordinate flashing with window installation.
- H. On exterior, install backer-rod in joint between window frame and flashed rough framing. Apply sealant at jambs and head, leaving sill unsealed. Apply sealants in accordance with sealant manufacturer's instructions and ASTM C1193.
- I. Position weather barrier head flap across head flashing. Adhere using 4-inch wide DuPont™ StraightFlash™ over the 45-degree seams.
- J. Tape head flap in accordance with manufacturer recommendations.
- K. On interior, install backer rod in joint between frame of window and flashed rough framing. Apply sealant around entire window to create air seal. Apply sealants per sealant manufacturer's instructions and ASTM C1193.

### 3.6 OPENING PREPARATION (for use with flanged windows)

- A. Cut weather barrier membrane in a modified "I-cut" pattern.
  - 1. Cut weather barrier horizontally along the bottom of the header.
  - 2. Cut weather barrier vertically 2/3 of the way down from top center of window opening.
  - 3. Cut weather barrier diagonally from bottom of center vertical cut to the left and right corners of the opening.
  - 4. Fold side and bottom weather barrier flaps into window opening and fasten.
- B. Cut a head flap at 45-degree angle in the weather barrier membrane at window head to expose 8 inches of sheathing. Temporarily secure weather barrier membrane flap away from sheathing with tape.

### 3.7 FLASHING (for use with flanged windows)

- A. Cut 9-inch wide DuPont™ FlexWrap™ a minimum of 12 inches longer than width of sill rough opening.
- B. Cover horizontal sill by aligning DuPont™ FlexWrap™ edge with inside edge of sill. Adhere to rough opening across sill and up jambs a minimum of 6 inches. Secure flashing tightly into corners by working in along the sill before adhering up the jambs.
- C. Fan DuPont™ FlexWrap™ at bottom corners onto face of wall. Firmly press in place. Mechanically fasten fanned edges.
- D. On exterior, apply continuous bead of sealant to wall or backside of window mounting flange across jambs and head. Do not apply sealant across sill.
- E. Install window according to manufacturer's instructions.
- F. Apply 4-inch wide strips of DuPont™ StraightFlash™ at jambs overlapping entire mounting flange. Extend jamb flashing 1-inch above top of rough opening and below bottom edge of sill flashing.
- G. Apply 4-inch wide strip of DuPont™ StraightFlash™ as head flashing overlapping the mounting flange. Head flashing should extend beyond outside edges of both jamb flashings.
- H. Position weather barrier head flap across head flashing. Adhere using 4-inch wide DuPont™ StraightFlash™ over the 45-degree seams.

- I. Tape head flap in accordance with manufacturer recommendations
- J. On interior, install backer rod in joint between frame of window and flashed rough framing. Apply sealant around entire window to create air seal. Apply sealant in accordance with sealant manufacturer's instructions and ASTM C1193.

### 3.8 PROTECTION

- A. Protect installed weather barrier from damage.

END OF SECTION

- A. Building Wrap: Air-retarder sheeting made from polyolefins; cross-laminated films, woven strands, or spun-bonded fibers; coated or uncoated; with or without perforations; and complying with ASTM E 1677, Type I.
  - 1. [Available ]Manufacturers:
    - a. Celotex Corporation (The); Building Products Division.
    - b. DuPont (E. I. du Pont de Nemours and Company).
    - c. Parsec, Inc.
    - d. Raven Industries, Inc.
    - e. Reemay, Inc.
    - f. Simplex Products.
    - g. Sto-Cote Products, Inc.
    - h. Tenneco Building Products.
  - 2. Thickness: Not less than 3 mils (0.08 mm).
  - 3. Permeance: Not less than 10 perms (575 ng/Pa x s x sq. m).
  - 4. Flame-Spread Index: 25 or less per ASTM E 84.
  - 5. Allowable Exposure Time: Not less than three months.
- B. Building Wrap Tape: Pressure-sensitive plastic tape recommended by building wrap manufacturer for sealing joints and penetrations in building wrap.
- C. Sheathing Tape: Pressure-sensitive plastic tape for sealing joints and penetrations in sheathing and recommended by sheathing manufacturer for use with type of sheathing required.
- D. Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch (25-mm) nominal thickness, compressible to 1/32 inch (0.8 mm); selected from manufacturer's standard widths to suit width of sill members indicated.

END OF SECTION 07 2500

SECTION 075323 - ETHYLENE-PROPYLENE-DIENE-MONOMER (EPDM) ROOFING

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. Fully adhered EPDM membrane roofing system.
- 2. Roof insulation.

B. Related Sections:

- 1. Division 05 Section "Steel Decking".
- 2. Division 06 Section "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking.
- 3. Division 07 Section "Thermal Insulation" for insulation beneath the roof deck.
- 4. Division 07 Section "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

1.3 DEFINITIONS

- A. Roofing Terminology: See ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definitions of terms related to roofing work in this Section.

1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.

Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.

roofing System Design: Provide membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7 and listed on the drawings.

Energy Performance: Provide roofing system with initial Solar Reflectance Index not less than 78 when calculated according to ASTM E 1980 based on testing identical products by a qualified testing agency.

SUBMITTALS

Product Data: For each type of product indicated.



- B. Manufacturer Certificate: Signed by roofing manufacturer certifying that membrane roofing system complies with requirements specified in "Performance Requirements" Article.
  - 1. Submit evidence of complying with performance requirements.
- C. Field quality-control reports.
- D. Maintenance Data: For membrane roofing system to include in maintenance manuals.
- E. Warranties: Sample of special warranties.

#### 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is UL listed for membrane roofing system identical to that used for this Project.
- B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.
- C. Source Limitations: Obtain components including roof insulation fasteners for membrane roofing system from same manufacturer as membrane roofing or approved by membrane roofing manufacturer.
- D. Fire-Resistance Ratings: Where indicated, provide fire-resistance-rated roof assemblies identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- E. Preinstallation Roofing Conference: Conduct conference at Project site.
  - 1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
  - 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
  - 3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - 4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
  - 5. Review structural loading limitations of roof deck during and after roofing.
  - 6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
  - 7. Review governing regulations and requirements for insurance and certificates if applicable.
  - 8. Review temporary protection requirements for roofing system during and after installation.
  - 9. Review roof observation and repair procedures after roofing installation.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
  - 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

## 1.8 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

## 1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard or customized form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period.
  - 1. Special warranty includes membrane roofing, base flashings, roof insulation, fasteners, roofing accessories, and other components of membrane roofing system.
  - 2. Warranty Period: 15 years from date of Substantial Completion.
- B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering Work of this Section, including all components of membrane roofing system such as membrane roofing, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, roof pavers, and walkway products, for the following warranty period:
  - 1. Warranty Period: Two years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 EPDM MEMBRANE ROOFING

- A. EPDM: ASTM D 4637, Type I, non-reinforced, uniform, flexible EPDM sheet.
  - 1. Provide products by one of the following:
    - a. Firestone Building Products – Rubbergard Ecowhite EPDM..
  - 2. Thickness: 60 mils, nominal.
  - 3. Exposed Face Color: White on black.

### 2.2 AUXILIARY MEMBRANE ROOFING MATERIALS

- A. General: Auxiliary membrane roofing materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.
  - 1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
- B. Sheet Flashing: 60-mil- thick EPDM, partially cured or cured, according to application.
- C. Bonding Adhesive: Manufacturer's standard.
- D. Seaming Material: Manufacturer's standard, synthetic-rubber polymer primer and 3-inch- wide minimum, butyl splice tape with release film.
- E. Lap Sealant: Manufacturer's standard, single-component sealant, colored to match membrane roofing.
- F. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.
- G. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in F M Approvals 4470, designed for fastening membrane to substrate, and acceptable to roofing system manufacturer.
- H. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, reinforced EPDM securement strips, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.

### 2.3 ROOF INSULATION

- A. Polyisocyanurate Board Insulation: A STM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.
- B. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

### 2.4 INSULATION ACCESSORIES

- A. General: Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with membrane roofing.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.
- C. Modified Asphaltic Insulation Adhesive: Insulation manufacturer's recommended modified asphalt, asbestos-free, cold-applied adhesive formulated to attach roof insulation to substrate or to another insulation layer.
- D. Bead-Applied Insulation Adhesive: Insulation manufacturer's recommended bead-applied, low-rise, one- or multicomponent urethane adhesive formulated to attach roof insulation to substrate or to another insulation layer.

### 2.5 WALKWAYS

- A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, solid-rubber, slip-resisting, surface-textured walkway pads or rolls, approximately 3/16 inch thick, and acceptable to membrane roofing system manufacturer.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
  - 1. Verify that roof openings and penetrations are in place and curbs are set and braced and that roof drain bodies are securely clamped in place.
  - 2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
  - 3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Division 05 Section "Steel Decking."
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- C. 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.
- D. Install a coustical roof deck rib insulation strips, specified in Division 05 Section " Steel Decking," according to acoustical roof deck manufacturer's written instructions, immediately before installation of overlying construction and to remain dry.

#### 3.3 INSULATION INSTALLATION

- A. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with membrane roofing system and insulation manufacturer's written instructions for installing roof insulation.
- C. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.
- D. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.

- E. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.
  - 1. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
- F. Adhered Insulation: Install each layer of insulation and adhere to substrate as follows:
- G. Mechanically Fastened and Adhered Insulation: Install first 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 ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
- 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 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.

### 3.4 FULLY ADHERED MEMBRANE ROOFING INSTALLATION

- A. Fully adhered membrane roofing over area to receive roofing according to roofing system manufacturer's written instructions. Unroll membrane roofing and allow to relax before installing.
  - 1. For in-splice attachment, install membrane roofing with long dimension perpendicular to steel roof deck flutes.
- B. Start installation of membrane roofing in presence of roofing system manufacturer's technical personnel.
- C. Accurately align membrane roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- D. Adhere membrane roofing securely at terminations, penetrations, and perimeter of roofing.
- E. Apply membrane roofing with side laps shingled with slope of roof deck where possible.
- F. Adhesive Seam Installation: Clean both faces of splice areas, apply splicing cement, and firmly roll side and end laps of overlapping membrane roofing according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of membrane roofing terminations.
  - 1. Apply a continuous bead of in-seam sealant before closing splice if required by membrane roofing system manufacturer.
- G. Repair tears, voids, and lapped seams in roofing that does not comply with requirements.
- H. Spread sealant or mastic bed over deck drain flange at roof drains and securely seal membrane roofing in place with clamping ring.
- I. In-Splice Attachment: Secure one edge of membrane roofing using fastening plates or metal battens centered within membrane splice and mechanically fasten membrane roofing to roof deck. Field splice seam.

- J. Install membrane roofing and auxiliary materials to tie in to existing roofing to maintain weather-tightness of transition and to not void warranty for existing membrane roofing system.

### 3.5 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane 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 splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.
- 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. Adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

### 3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Engage qualified independent testing agency to perform inspections.
- B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.
- C. Repair or remove and replace components of membrane roofing system where inspections indicate that they do not comply with specified requirements.
- D. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

### 3.8 PROTECTING AND CLEANING

- A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will 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 membrane roofing system that does not comply with requirements, repair substrates and repair or reinstall membrane 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.

3.9 ROOFING INSTALLER'S WARRANTY

- A. WHEREAS \_\_\_\_\_ of \_\_\_\_\_, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:
1. Owner: \_\_\_\_\_
  2. Address: \_\_\_\_\_
  3. Building Name/Type: \_\_\_\_\_
  4. Address: \_\_\_\_\_
  5. Area of Work: \_\_\_\_\_
  6. Acceptance Date: \_\_\_\_\_
  7. Warranty Period: \_\_\_\_\_
  8. Expiration Date: \_\_\_\_\_
- B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,
- C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.
- D. This Warranty is made subject to the following terms and conditions:
1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
    - a. Lightning;
    - b. Peak gust wind speed exceeding listed on drawings;
    - c. Fire;
    - d. Failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
    - e. Faulty construction of parapet walls, copings, clear story, vents, equipment supports, and other edge conditions and penetrations of the work;
    - f. Vapor condensation on bottom of roofing; and
    - g. Activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.
  2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
  3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
  4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.

5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this \_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_.

1. Authorized Signature: \_\_\_\_\_
2. Name: \_\_\_\_\_
3. Title: \_\_\_\_\_

END OF SECTION 075323



SECTION 07 6100 - SHEET METAL ROOFING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Aluminum-zinc alloy (Galvalume)
  - 2. Underlayment.
  - 3. Flashings, trim, and accessories.
  - 4. Specification based on Sheffield Metals CoolR metal roof system.
  
- B. Related Sections:
  - 1. Division 01: Administrative, procedural, and temporary work requirements.
  - 2. Section 07 9200 - Joint Sealers.
  - 3. Section 07 6200-Sheet Metal Flashing and Trim
  - 4. Section 07 7100 - Roof Specialties

1.2 REFERENCES

- A. American Society of Civil Engineers (ASCE) 7 - Minimum Design Loads for Buildings and Other Structures.
  
- B. ASTM International (ASTM):
  - 1. A755/A755M - Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
  - 2. A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
  - 3. B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.
  - 4. B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
  - 5. C1371 - Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emisometers.
  - 6. D226 - Standard Specification for Asphalt Saturated Organic Felt Used in Roofing and Waterproofing.
  - 7. D412 - Standard Test Method for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension.
  - 8. D523 - Standard Test Method for Specular Gloss.
  - 9. D968 - Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive.
  - 10. D1308 - Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes.
  - 11. D1970 - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
  - 12. D2247 - Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.
  - 13. D2794 - Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
  - 14. D3359 - Standard Test Methods for Measuring Adhesion by Tape Test.
  - 15. D3363 - Standard Test Method for Film Hardness by Pencil Test.
  - 16. E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
  - 17. E408 - Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques.
  - 18. E1592 - Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference.
  - 19. E1980 - Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces.
  - 20. G53 - Practice for Operating Light- and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Nonmetallic Materials.
  - 21. D522 - Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings.

### 1.3 SYSTEM DESCRIPTION

- A. Design Requirements; design roof system to withstand:
  - 1. Live and dead loads in accordance with Building Code.
  - 2. Minimum wind pressures in accordance with ASCE 7, IBC 2009 tested in accordance with ASTM E1592.
  - 3. Movement caused by an ambient temperature range of 120 degrees F and a surface temperature range of 160 degrees F.

### 1.4 SUBMITTALS

- A. Submittals for Review:
  - 1. Shop Drawings: Include dimensioned layout showing locations of seams, accessories, gage of metal, fastening methods, provisions for expansion and contraction, and details of joints.
  - 2. Samples: Each profile proposed for use.
- B. Sustainable Design Submittals:
  - 1. Solar Reflectance Index: Certify initial [and 3-year] solar reflectance index of metal roofing.
  - 2. Recycled Content: Certify recycled content of metal roofing; indicate recycled content percent and whether pre-consumer or post-consumer.
  - 3. Regional Materials: Certify materials extracted, processed, and manufactured within 500 mile radius of Project site.

### 1.5 QUALITY ASSURANCE

- A. Mockup:
  - 1. Size: 4 x 4 feet.
  - 2. Include: Underlayment, roofing, flashings, and trim.
  - 3. Locate on site.
  - 4. Approved mockup may remain as part of the Work.

### 1.6 PROJECT CONDITIONS

- A. Do not apply underlayment at ambient or surface temperatures less than 40 degrees F or on wet or frozen substrate.
- B. Do not install roofing on wet or frozen substrate.

### 1.7 WARRANTIES

- A. Furnish manufacturer's 20 year warranty providing coverage against water leakage through roofing system. Include roof panels and side seams, panel end laps, roof-to-wall flashings, ridge flashings, hip flashings, valley flashings, high-side eave flashings, rake flashings, expansion joint flashings, and manufacturer-approved curb and penetration flashings.

## **PART 2 PRODUCTS**

### 2.1 MATERIALS

- A. Aluminum-Zinc Alloy Coated (Galvalume) Steel Sheet:
  - 1. ASTM A792/A792M, Structural Grade, AZ50 aluminum-zinc alloy coating, 24 gage core steel.

### 2.2 ACCESSORIES

- A. Underlayment:
  - 1. Description: ASTM D1970; minimum 30 mil thick polymer modified asphalt laminated to slip-resistant polyethylene film, self adhering with release paper facing.
  - 2. Elongation: Minimum 250 percent, tested to ASTM D412.

- 3. Tensile strength: Minimum 250 PSI, tested to ASTM D412
- B. Panel Clips: Stainless steel, thermally responsive.
- C. Fasteners: Same material and finish as sheet metal, with neoprene gasketed washers where exposed.
- D. Underlayment Fasteners: Hot dip galvanized steel, length to penetrate minimum 3/4 inch into sheathing.
- E. Joint Sealers: Specified in Section 07 9200
- F. Sheet Metal Flashing and Trim 07 6200
- G. Touch-Up Pens: CoolR touch up pens provided by manufacturer in color to match panel finish.

### 2.3 FINISHES

- A. Panels and Trim: ASTM A755/A755M; CoolR fluoropolymer coating applied to sheets in coil form, color to be Pantone 540 blue.
- B. Coating Performance Requirements:
  - 1. Specular gloss: 25 to 35 at 60 degrees; tested to ASTM D523.
  - 2. Abrasion resistance: Total 67 liters sand plus or minus 10 liters; tested to D968.
  - 3. Acid resistance: Tested to D1308.
    - a. 10 percent hydrochloric acid at 24 hours: No visible change.
    - b. 20 percent hydrochloric acid at 18 hours: No visible change.
    - c. 20 percent sulfuric acid at 18 hours: No visible change.
    - d. 25 percent sodium hydroxide at 1 hour: No visible change.
    - e. 20 percent muriatic acid at 15 minutes: No visible change.
  - 4. Humidity resistance: 2000 hours, Rating 10, no blisters; tested to D2247.
  - 5. Impact resistance: 3.0 times metal thickness in inch-pounds without loss of adhesion; tested to D2294.
  - 6. Adhesion: No loss of adhesion; tested to ASTM D3359.
  - 7. Pencil hardness: Hb minimum; tested to ASTM D3363.
  - 8. Surface burning characteristics: Class A; tested to ASTM E84.
  - 9. Accelerated weathering: 2000 hours, No. 8 chalk, Color 2 E; tested to ASTM G53.
  - 10. Formability: 1/8 inch mandrel, no cracking or loss of adhesion; tested to ASTM D522.
  - 11. Salt spray resistance: 1000 hours, Scribe 7, 1/16 inch blisters, Field 10, no blisters; tested to ASTM B117.
- C. Panels and Trim: High-performance clear acrylic coating.

## PART 3 EXECUTION

### 3.1 INSTALLATION OF UNDERLAYMENT

- A. Starting at low edge, apply underlayment horizontally on roof.
- B. Weatherlap each sheet 4 inches over preceding sheet. Lap ends 6 inches minimum.
- C. Press to full bond with substrate without voids, wrinkles, bridging, or fishmouths. Seal ends and edges.
- D. Lap underlayment minimum 12 inches over hips and ridges from both sides. Apply 36 inch wide strip centered lengthwise over ridge.
- E. Extend minimum 4 inches up abutting vertical surfaces.

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### 3.2 INSTALLATION OF ROOFING

- A. Fabricate roofing panels using approved roll forming equipment.
- B. Form roofing to provide 1-1/2 inch high standing seams spaced nominally 20 inches on center.
- C. Form panels in single lengths from eave to ridge.
- D. Form sections true to shape, accurate in size, square, and free from distortion and defects.
- E. Apply roofing panels beginning at low edge of roof.
- F. Panel end joints not permitted.
- G. Fit flashings with square corners and surfaces true, aligned, and accurate to required profiles.
- H. Fasten panels to supports using concealed panel clips. Exposed fasteners permitted on trim members only.
- I. Install trim to maintain visual continuity of system.
- J. Install joint sealers and gaskets to prevent water penetration.
- K. Flash penetrations through roofing with metal trim to match panels:
  - 1. Lap flashings over roof panels 12 inches minimum on all sides and seal with double bead of joint sealer.
  - 2. Install metal draw band and joint sealer at top of pipe penetrations.
  - 3. Install water diverter at uphill side of square and rectangular penetrations.
- L. Installation Tolerances:
  - 1. Variation from location: Plus or minus 1/4 inch.
  - 2. Variation from plane: 1/4 inch in 10 feet.

### 3.3 ADJUSTING

- A. Touch up field cuts and abrasions to match factory finish using touch-up pens.

END OF SECTION

SECTION 07 6200 - SHEET METAL FLASHING AND TRIM

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. Manufactured Products:
    - a. Manufactured through-wall flashing and counterflashing.
  - 2. Formed Products:
    - a. Formed roof drainage sheet metal fabrications.
    - b. Formed wall sheet metal fabrications.
    - c. Low roof sheet metal fabrications.
- B. Related Sections:
  - 1. Division 06 Section "Rough Carpentry for wood nailers, curbs, and blocking.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies as indicated 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. Fabricate and install roof edge flashing capable of resisting the following forces according to recommendations in FMG Loss Prevention Data Sheet 1-49:
- C. Thermal Movements: Provide sheet metal flashing and trim that allows for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
- B. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work. Include the following:
  - 1. Identification of material, thickness, weight, and finish for each item and location in Project.
  - 2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
  - 3. Details for joining, supporting, and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips, and other attachments. Include pattern of seams.
  - 4. Details of termination points and assemblies, including fixed points.
  - 5. Details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction.

6. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
  7. Details of special conditions.
  8. Details of connections to adjoining work.
  9. Detail formed flashing and trim at a scale of not less than 1-1/2 inches per 12 inches (1:10).
- C. Samples for Initial Selection: For each type of sheet metal flashing, trim, and accessory indicated with factory-applied color finishes involving color selection.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
1. Sheet Metal Flashing: 12 inches (300 mm) long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
  2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches (300 mm) long and in required profile. Include fasteners and other exposed accessories.
  3. Accessories and Miscellaneous Materials: Full-size Sample.
  4. Anodized Aluminum Samples: Samples to show full range to be expected for each color required.
- E. Qualification Data: For qualified fabricator.
- F. Maintenance Data: For sheet metal flashing, trim, and accessories to include in maintenance manuals.
- G. Warranty: Sample of special warranty.

#### 1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that 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.
- B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

#### 1.7 WARRANTY

- A. Special Warranty on Finishes: Manufacturer's standard form in which 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. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  2. Finish Warranty Period: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.
- B. Metallic-Coated Steel Sheet: Restricted flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
  - 1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation; structural quality.
  - 2. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40 (Class AZM150 coating designation, Grade 275); structural quality.
  - 3. Surface: Smooth, flat.
  - 4. Exposed Coil-Coated Finish:
    - a. Two-Coat Fluoropolymer: AAMA 621. 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.
  - 5. Color: As scheduled.
  - 6. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

### 2.2 UNDERLAYMENT MATERIALS

- A. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
- B. Slip Sheet: Building paper, 3-lb/100 sq. ft. (0.16-kg/sq. m) minimum, rosin sized.

### 2.3 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and 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.
    - 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: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329 or Series 300 stainless steel.
  - 3. Fasteners for Zinc Sheet: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329 or Series 300 stainless steel.
- 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, gray 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 polyurethane polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- F. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

#### 2.4 ROOF DRAINAGE SHEET METAL FABRICATIONS

- A. Downspouts: Fabricate rectangular downspouts complete with mitered elbows. Furnish with metal hangers, from same material as downspouts, and anchors.
  - 1. Fabricated Hanger Style: SMACNA figure designation 1-35B.
  - 2. Fabricate from the following materials:
    - a. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch (0.56 mm) thick.
- B. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and shape indicated complete with outlet tubes, exterior flange trim, and built-in overflows. Fabricate from the following materials:
- C. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch (0.71 mm) thick. Parapet Scuppers: Fabricate scuppers of 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. Fasten gravel guard angles to base of scupper. Fabricate from the following materials:
  - 1. Galvanized Steel: 0.028 inch (0.71 mm) thick, where not visible from building exterior.
  - 2. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch (0.71 mm) thick, where visible from building exterior.

#### 2.5 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Roof-Edge Flashing and Fascia Cap: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 10-foot- (3-m-) long, sections. Furnish with 6-inch- (150-mm-) wide, joint cover plates. Fabricate from the following materials:
  - 1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch (0.71 mm) thick.
- B. Copings: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 10-foot- (3-m-) long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, seal, and solder or weld watertight. Fabricate from the following materials:
  - 1. Aluminum-Zinc Alloy-Coated Steel: 0.040 inch (1.02 mm) thick.
- C. Base Flashing: Fabricate from the following materials:
  - 1. Galvanized Steel: 0.028 inch (0.71 mm) thick, where not visible from building exterior.
  - 2. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch (0.71 mm) thick, where visible from building exterior.
- 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.



## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.
  - 1. Verify compliance with requirements for installation tolerances of substrates.
  - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 UNDERLAYMENT INSTALLATION

- A. General: Install underlayment as indicated on Drawings.
- B. Felt Underlayment: Install felt underlayment with adhesive for temporary anchorage 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).

## 3.3 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, welding rods, 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 and levels indicated. 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. Anchor each cleat with two fasteners. Bend tabs over fasteners.
  - 4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
  - 5. Install sealant tape where indicated.
  - 6. Torch cutting of sheet metal flashing and trim is not permitted.
  - 7. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.
  - 1. Coat back side of uncoated aluminum and stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
  - 2. Underlayment: Where installing metal flashing 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. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (600 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.

- D. Fastener Sizes: Use fasteners of sizes that will penetrate wood decking not less than recommended by fastener manufacturer to achieve maximum pull-out resistance. Seal joints as shown and as required for watertight construction.
  - 1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).
  - 2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."
- E. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches (38 mm), except reduce pre-tinning where pre-tinned surface would show in completed Work.
- F. Rivets: Rivet joints in uncoated aluminum where indicated and where necessary for strength.

### 3.4 ROOF DRAINAGE SYSTEM INSTALLATION

- A. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.
- B. Downspouts: Join sections with 1-1/2-inch (38-mm) telescoping joints.
  - 1. 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. in between.
  - 2. Provide elbows at base of downspout to direct water away from building.
  - 3. Provide precast concrete splash blocks where downspouts discharge onto landscaped surfaces.
- C. Conductor Heads: Anchor securely to wall with elevation of conductor head rim 1 inch (25 mm) below as indicated on drawings discharge.

### 3.5 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
- B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in SMACNA's "Architectural Sheet Metal Manual" and as indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch (75-mm) centers.
- C. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches (100 mm) over base flashing. Install stainless-steel draw band and tighten.
- D. 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 a minimum of 4 inches (100 mm) and bed with sealant. Secure in a waterproof manner by means of interlocking folded seam or blind rivets and sealant.
- E. 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.

3.6 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches (100 mm) beyond wall openings.

3.7 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.
- B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.8 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. On completion of installation, remove unused materials and clean finished surfaces. Maintain in a clean condition during construction.
- E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 6200

## SECTION 077100 - ROOF 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. Box Beam.
- 2. Roof-edge drainage systems.
- 3. Reglets and counterflashings.

- B. Related Sections:

- 1. Division 06 Section "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking.
- 2. Division 07 Section "Sheet Metal Roofing" for roof-edge drainage-system components provided by metal-roof-panel manufacturer.
- 3. Division 07 Section "Joint Sealants" for field-applied sealants between roof specialties and adjacent materials.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. General Performance: Roof specialties shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
- B. FM Approvals' Listing: Manufacture and install cornices that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-90. Identify materials with FM Approvals' markings.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. 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.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Samples for Initial Selection: For each type of roof specialty indicated with factory-applied color finishes.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency.
- D. Maintenance Data: For roofing specialties to include in maintenance manuals.
- E. Warranty: Sample of special warranty.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not store roof specialties in contact with other materials that might cause staining, denting, or other surface damage. Store roof specialties away from uncured concrete and masonry.
- B. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof specialties installation.

#### 1.6 WARRANTY

- A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 EXPOSED METALS

- A. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper to suit forming operations and performance required.
  - 1. Surface: Smooth, flat finish.
  - 2. Mill Finish: As manufactured.
  - 3. Exposed Coil-Coated Finishes: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

- a. Two-Coat Fluoropolymer: AAMA 620. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.
  - b. Concealed Surface: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.
4. Clear Anodic Finish, Coil Coated: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

## 2.2 CONCEALED METALS

- A. Aluminum Sheet: ASTM B 209, alloy and temper recommended by manufacturer for type of use and structural performance indicated, mill finished.

## 2.3 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. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:
1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
  2. Fasteners for Aluminum: Aluminum or Series 300 stainless steel.
- C. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.
- D. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- E. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.
- F. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

## 2.4 Box Beam

- A. Box Beam: Manufactured coping system consisting of formed-metal in section lengths not exceeding 6 feet, concealed anchorage; corner units, end cap units, and concealed splice plates with same finish as Box Beam.
1. Box Beam Material: Formed aluminum, 0.082 inch thick.
    - a. Finish: Two-coat fluoropolymer.
    - b. Color: To match permadized sterling gray storefront finish.

2. Corners: Factory mitered and continuously welded.

## 2.5 ROOF-EDGE DRAINAGE SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. Architectural Products Company.
  2. ATAS International, Inc.
  3. Cheney Flashing Company.
  4. Hickman Company, W. P.
  5. .
- B. Gutters: Manufactured in uniform section lengths not exceeding 12 feet, with matching corner units, ends, outlet tubes, and other accessories. Elevate back edge at least 1 inch above front edge. Furnish flat-stock gutter straps, gutter brackets, expansion joints, and expansion-joint covers fabricated from same metal as gutters.
  1. Fabricate from the following exposed metal:
    - a. Formed Aluminum: 0.050 inch thick.
  2. Gutter Profile: As indicated according to SMACNA's " Architectural Sheet Metal Manual."
  3. Corners: Factory mitered and continuously welded.
  4. Gutter Supports: Manufacturer's standard supports as selected by Architect with finish matching the gutters.
  5. Gutter Accessories: Flat ends.
- C. Downspouts: Plain rectangular complete with mitered elbows, manufactured from the following exposed metal. Furnish with metal hangers, from same material as downspouts, and anchors.
  1. Formed Aluminum: 0.050 inch thick.
- D. Parapet Scuppers: Manufactured with closure flange trim to exterior, 4-inch- wide wall flanges to interior, and base extending 4 inches beyond cant or tapered strip into field of roof.
  1. Fabricate from the following exposed metal:
    - a. Formed Aluminum: 0.050 inch thick.
- E. Aluminum Finish: Two-coat fluoropolymer.
  1. Color: Gutters to match exterior storefront. Downspout to match face brick.

## 2.6 REGLETS AND COUNTERFLASHINGS

- 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. Castle Metal Products.
2. Cheney Flashing Company.
3. Fry Reglet Corporation.
4. Heckmann Building Products Inc.
5. Hickman Company, W. P.
6. Keystone Flashing Company, Inc.
7. Metal-Era, Inc.
8. Metal-Fab Manufacturing, LLC.
9. MM Systems Corporation.
10. National Sheet Metal Systems, Inc.

B. Reglets: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces, from the following exposed metal:

1. Formed Aluminum: 0.050 inch thick.
2. Corners: Factory mitered and continuously welded.
3. Masonry Type, Embedded: Provide reglets with offset top flange for embedment in masonry mortar joint.

C. Counterflashings: Manufactured units of heights to overlap top edges of base flashings by 4 inches and in lengths not exceeding 12 feet designed to snap into reglets or through-wall-flashing receiver and compress against base flashings with joints lapped, from the following exposed metal:

1. Formed Aluminum: 0.032 inch thick.

D. Accessories:

1. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where reglet is provided separate from metal counterflashing.
2. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.

E. Aluminum Finish: Two-coat fluoropolymer.

1. Color: To match adjacent surface other than brick.

## 2.7 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical and painted 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.



## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
- B. Examine walls, roof edges, and parapets for suitable conditions for roof specialties.
- C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. General: Install roof specialties according to manufacturer's written instructions. Anchor roof specialties 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 roof-specialty systems.
  - 1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
  - 2. Provide uniform, neat seams with minimum exposure of solder and sealant.
  - 3. Install roof specialties to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
  - 4. Torch cutting of roof specialties is not permitted.
  - 5. Do not use graphite pencils to mark metal surfaces.
- 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 specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
  - 2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.
- C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.
  - 1. Space movement joints at a maximum of 12 feet with no joints within 18 inches of corners or intersections unless otherwise shown on Drawings.
  - 2. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.
- D. Fastener Sizes: Use fasteners of sizes that will penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- E. Seal joints with elastomeric sealant as required by roofing-specialty manufacturer.

- F. Seal joints as required for watertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F.

### 3.3 BOX BEAM INSTALLATION

- A. Install anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.

### 3.4 ROOF-EDGE DRAINAGE-SYSTEM INSTALLATION

- A. General: Install components to produce a complete roof-edge drainage system according to manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof-edge drainage system.
- B. Gutters: Join and seal gutter lengths. Allow for thermal expansion. Attach gutters to firmly anchored gutter supports spaced not more than 24 inches apart. Attach ends with rivets and seal with sealant to make watertight. Slope to downspouts.
  - 1. Install gutter with expansion joints at locations indicated but not exceeding 50 feet apart. Install expansion joint caps.
- C. Downspouts: Join sections with manufacturer's standard telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls and 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c.
  - 1. Provide elbows at base of downspout to direct water away from building at roof.
  - 2. Connect downspouts to underground drainage system indicated.

### 3.5 REGLET AND COUNTERFLASHING INSTALLATION

- A. General: Coordinate installation of reglets and counterflashings with installation of base flashings.
- B. Embedded Reglets: See Division 04 Section "Unit Masonry" for installation of reglets.
- C. Counterflashings: Insert counterflashings into reglets or other indicated receivers; ensure that counterflashings overlap 4 inches over top edge of base flashings. Lap counterflashing joints a minimum of 4 inches and bed with elastomeric sealant. Fit counterflashings tightly to base flashings.

### 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 and sealants.

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- C. Remove temporary protective coverings and strippable films as roof specialties are installed. On completion of installation, clean finished surfaces including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain roof specialties in a clean condition during construction.
- D. Replace roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077100

SECTION 079200 - JOINT SEALANTS

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. Silicone joint sealants.
2. Control joints.
3. Joints between dissimilar materials.
4. Joints between plumbing and adjoining walls, etc.

B. Related Sections:

1. Division 04 Section "Unit Masonry" for masonry control and expansion joint fillers and gaskets.
2. Division 08 Section "Glazing" for glazing sealants.
3. Division 09 Section "Gypsum Board" for sealing perimeter joints.
4. Division 09 Section "Tiling" for sealing tile joints.
5. Division 09 Section "Acoustical Panel Ceilings" for sealing edge moldings at perimeters with acoustical sealant.
6. Division 32 Section "Concrete Paving Joint Sealants" for sealing joints in pavements, walkways, and curbing.

1.3 PRECONSTRUCTION TESTING

- A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Submit not fewer than eight pieces of each kind of material, including joint substrates, sills, joint-sealant backings, secondary seals, and miscellaneous materials.
3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

- B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:

1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
2. Conduct field tests for each application indicated below:

- a. Each kind of sealant and joint substrate indicated.
3. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
  - a. 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.
    - 1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

#### 1.4 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for Verification: For each kind and color of joint sealant required.
- C. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.
- D. Warranties: Sample of special warranties.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.
- C. Product Testing: Test joint sealants using a qualified testing agency.
  1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
  2. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.
- D. Preinstallation Conference: Conduct conference at Project site.

#### 1.6 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
  1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
  2. When joint substrates are wet.
  3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
  4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 WARRANTY

- A. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

- 1. Warranty Period: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
  - 1. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.
- C. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- D. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.
- E. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

- A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.
  - 1. Products: Subject to compliance with requirements,:
    - a. Tremco Incorporated; Spectrem 800.

2.3 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) or any preceding type 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.

## 2.4 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, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 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 all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
  - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
    - a. Concrete.
    - b. Masonry.
    - c. Unglazed surfaces of ceramic tile.
  - 3. Remove laitance and form-release agents from concrete.
  - 4. 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 of joint sealants. Nonporous joint substrates include the following:
    - a. Metal.

- b. Glass.
  - c. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### 3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. 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.
  - 1. Do not leave gaps between ends of sealant backings.
  - 2. Do not stretch, twist, puncture, or tear sealant backings.
  - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. 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.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
  - 1. Remove excess sealant from surfaces adjacent to joints.
  - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
  - 3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
  - 4. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.
  - 5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C 1193.
    - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.



### 3.4 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 of joint length for each kind of sealant and joint substrate.
  - b. Perform 1 test for each 1000 feet of joint length thereafter or 1 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.
  - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
3. Inspect tested joints and report on the following:
  - a. Whether sealants filled joint cavities and are free of voids.
  - b. Whether sealant dimensions and configurations comply with specified requirements.
  - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

#### 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.

### 3.5 CLEANING

- #### A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

### 3.6 PROTECTION

- #### A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.
  - 1. Joint Locations:
    - a. Control and expansion joints in brick pavers.
    - b. Isolation and contraction joints in cast-in-place concrete slabs.
  - 2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
  - 1. Joint Locations:
    - a. Control and expansion joints in unit masonry.
    - b. Joints between metal panels.
    - c. Joints between different materials listed above.
    - d. Perimeter joints between materials listed above and frames of doors and windows.
  - 2. Silicone Joint Sealant: Single component, nonsag, neutral curing, Class 100/50.
  - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- C. Joint-Sealant Application: Interior acoustical joints in vertical surfaces and horizontal nontraffic surfaces.
  - 1. Joint Location:
    - a. Acoustical joints where indicated.
  - 2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

END OF SECTION 079200

## SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Standard hollow metal doors and frames.
  - 2. Custom hollow metal frames.

#### 1.2 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings.
- B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.
- C. Custom Hollow Metal Work: Hollow metal work fabricated according to ANSI/NAAMM-HMMA 861.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, fire-resistance rating, and finishes.
- B. Shop Drawings: Include the following:
  - 1. Elevations of each door design.
  - 2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
  - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
  - 4. Locations of reinforcement and preparations for hardware.
  - 5. Details of each different wall opening condition.
  - 6. Details of anchorages, joints, field splices, and connections.
  - 7. Details of accessories.
  - 8. Details of moldings, removable stops, and glazing.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Samples for Verification:
  - 1. For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches.
  - 2. For the following items, prepared on Samples about 12 by 12 inches to demonstrate compliance with requirements for quality of materials and construction:

- a. Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.
- b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow metal panels and glazing if applicable.

#### 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.
- B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80-1999 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252-1999 or UL 10C-1998 Category B. Where door assembly specifications require Category B positive pressure fire doors only those seals gaskets, etc. indicated in the manufactures' installation instructions and listing requirements shall be installed.
- C. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80-1999 that are 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 257-2000 or UL 9. Label each individual glazed lite.
- D. Preinstallation Conference: Conduct conference at Project site.
- E. All modifications to fire doors and frames for electric and mortised hardware shall be made by the respective door and frame manufacturers NFPA 80-1999.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

#### 1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

#### 1.7 COORDINATION

- A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Amweld Building Products, LLC.
  - 2. Ceco Door Products; an Assa Abloy Group company.
  - 3. Curries Company; an Assa Abloy Group company.
  - 4. Steelcraft; an Ingersoll-Rand company.
  - 5. Or equal.

### 2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum A40 metallic coating.
- C. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z 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.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- E. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow metal frames of type indicated.
- F. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.
- G. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. density; with maximum flame-spread and smoke-development indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- H. Glazing: Comply with requirements in Division 08 Section "Glazing."
- I. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

## 2.3 STANDARD HOLLOW METAL DOORS

- A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.
1. Design: As indicated.
  2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core.
    - a. Fire Door Core: As required to provide fire-protection ratings indicated.
    - b. Thermal-Rated (Insulated) Doors: Where indicated, provide doors fabricated with thermal-resistance value (R-value) of not less than 6.0 deg F x h x sq. ft./Btu when tested according to ASTM C 1363.
      - 1) Locations: Exterior doors.
  3. Vertical Edges for Single-Acting Doors: Manufacturer's standard.
  4. Vertical Edges for Double-Acting Doors: Round vertical edges with 2-1/8-inch radius.
  5. Top and Bottom Edges: Closed with flush or inverted 0.042-inch-thick, end closures or channels of same material as face sheets.
  6. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
- B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
1. Level 2 and Physical Performance Level B (Heavy Duty), Model 1 (Full Flush).
  2. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 1 (Full Flush).
- C. Interior Doors: Face sheets fabricated from cold-rolled steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
1. Level 2 and Physical Performance Level B (Heavy Duty), Model 1 (Full Flush).
  2. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 1 (Full Flush).
- D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
- E. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

## 2.4 STANDARD HOLLOW METAL FRAMES

- A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.
- B. Exterior Frames: Fabricated from metallic-coated steel sheet.

1. Fabricate frames with mitered or coped corners.
2. Fabricate frames as welded units unless otherwise indicated.
3. Frames for Level 2 Steel Doors: 0.053-inch- thick steel sheet.
4. Frames for Level 3 Steel Doors: 0.053-inch- thick steel sheet.

C. Interior Frames: Fabricated from cold-rolled steel sheet.

1. Fabricate frames with mitered or coped corners.
2. Fabricate frames as welded units unless otherwise indicated.
3. Frames for Level 2 Steel Doors: 0.053-inch- thick steel sheet.
4. Frames for Level 3 Steel Doors: 0.053-inch- thick steel sheet.
5. Frames for Wood Doors: 0.053-inch- thick steel sheet.
6. Frames for Borrowed Lights: 0.053-inch- thick steel sheet.

D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

## 2.5 CUSTOM HOLLOW METAL FRAMES

A. General: Fabricate frames of construction indicated. Close contact edges of corner joints tight with faces mitered and stops butted or mitered. Continuously weld faces and soffits and finish faces smooth. Comply with ANSI/NAAMM-HMMA 861.

1. Sidelight and Transom Frames: Fabricated from same thickness material as adjacent door frame.
2. Borrowed-Light Frames: Fabricated from 0.053-inch- thick steel sheet.

B. Hardware Reinforcement: Fabricate according to ANSI/NAAMM-HMMA 861 with reinforcing plates from same material as frame.

C. Head Reinforcement: Provide minimum 0.093-inch- thick, steel channel or angle stiffener for opening widths more than 48 inches.

## 2.6 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 thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.

B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick, 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 height adjustment. Terminate bottom of frames at finish floor surface.

## 2.7 STOPS AND MOLDINGS

- A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch thick, fabricated from same material as door face sheet in which they are installed.
- B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch high unless otherwise indicated.
- C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch thick, fabricated from same material as frames in which they are installed.

## 2.8 ACCESSORIES

- A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
- B. Ceiling Struts: Minimum 1/4-inch-thick by 1-inch-wide steel.
- C. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

## 2.9 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 thickness of metal. 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. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.
- C. Hollow Metal Doors:
  - 1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
  - 2. Glazed Lites: Factory cut openings in doors.
  - 3. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80-1999 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.
- D. 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. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
  - 2. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
  - 3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
  - 4. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.



5. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
  6. Jamb Anchors: Provide number and spacing of anchors as follows:
    - a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
      - 1) Two anchors per jamb up to 60 inches high.
      - 2) Three anchors per jamb from 60 to 90 inches high.
    - b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
      - 1) Three anchors per jamb up to 60 inches high.
      - 2) Four anchors per jamb from 60 to 90 inches high.
    - c. Compression Type: Not less than two anchors in each jamb.
    - d. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
  7. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.
    - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.
- F. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware and electronic hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
  2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
  3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
- G. Stops and Moldings: Provide stops and moldings around glazed lites 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 type of glazing and type of installation indicated.

## 2.10 STEEL FINISHES

- A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.
  1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:
  1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
  2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
  3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
  4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.
- C. Drill and tap doors and frames to receive non templated, mortised, and surface-mounted door hardware.

### 3.3 INSTALLATION

- A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
1. Do not field modify fire-rated door assemblies.
- B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.
1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
    - a. At fire-protection-rated openings, install frames according to NFPA 80-1999.
    - 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 glazing 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 plumbness, squareness, 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 are 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 powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
  3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind 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 grout. Take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.
  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 Gypsum Board Partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
  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, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.

- b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
  - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
  - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
- 1. Non-Fire-Rated Standard Steel Doors:
    - a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
    - b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
    - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
    - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.
  - 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80-1999.
  - 3. Smoke-Control Doors: Install doors according to NFPA 105.
- D. Glazing: Comply with installation requirements in Division 08 Section "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 o.c. and not more than 2 inches o.c. from each corner.

### 3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal 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 Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 081113

SECTION 081216 - ALUMINUM FRAMES

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. Interior aluminum frames for doors.

- B. Related Sections include the following:

- 1. Division 06 Section "Miscellaneous Rough Carpentry" for carpentry for wood framing and blocking.
  - 2. Division 07 Section "Joint Sealants" for joint sealants installed with interior aluminum frames and for sealants to the extent not specified in this Section.
  - 3. Division 08 Section "Flush Wood Doors" for wood doors installed in interior aluminum frames.
  - 4. Division 08 Section "Aluminum-Framed Entrances and Storefronts" for aluminum-framed doors installed in interior aluminum frames.
  - 5. Division 08 Section "Door Hardware" for door hardware.

1.3 SUBMITTALS

- A. Shop Drawings: For interior aluminum frames. Include plans, elevations, sections, details, and attachments to other work.

1.4 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of interior aluminum frames and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The design for interior aluminum frames is based on Omega Door Frame Products, Inc.; Omega Aluminum Frame System.

2.2 COMPONENTS

## NFCU

- A. Aluminum Framing, General: ASTM B 221, Alloy 6063 -T5 or alloy and temper required to suit structural and finish requirements, not less than 0.062 inch thick.
- B. Door Frames: Reinforced for hinges and strikes.
- C. Ceiling Tracks: Extruded aluminum.
- D. Trim: Extruded aluminum, not less than 0.062 inch thick, with removable snap-in casing trim without exposed fasteners.

### 2.3 ACCESSORIES

- A. Fasteners: Aluminum, nonmagnetic stainless-steel or other noncorrosive metal fasteners compatible with frames, stops, panels, reinforcement plates, hardware, anchors, and other items being fastened.
- B. Sound Seals: Manufacturer's standard continuous mohair, wool pile, or vinyl seals.
- C. Smoke Seals: Intumescent strip or fire-rated gaskets.
- D. Hardware: Comply with requirements in Division 08 door hardware Sections.

### 2.4 FABRICATION

- A. Machine jambs and prepare for hardware, with concealed reinforcement plates, drilled and tapped as required, and fastened within frame with concealed screws.
- B. Provide concealed corner reinforcements and alignment clips for accurately fitted hairline joints at butted or mitered connections.
- C. Fabricate all components to allow secure installation without exposed fasteners.

### 2.5 ALUMINUM FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- C. Finish: KAWNEER Permadize Finish- Sterling Gray.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine walls, floors, and ceilings, with Installer present, for conditions affecting performance of work.
  - 1. Verify that wall thickness does not exceed standard tolerances allowed by throat size indicated.
  - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with frame manufacturer's written installation instructions.
- B. Install frames plumb and square, securely anchored to substrates.
- C. Install frame components in the longest possible lengths; components up to 86 inches long must be 1 piece.
  - 1. Use concealed installation clips to produce tightly fitted and aligned splices and connections.
  - 2. Secure clips to main structural extrusion components and not to snap-in or trim members.
  - 3. Do not leave screws or other fasteners exposed to view when installation is complete.

### 3.3 CLEANING

- A. Clean exposed frame surfaces promptly after installation, using cleaning methods recommended by frame manufacturer and according to AAMA 609 & 610.
- B. Touch up marred frame surfaces so touchup is not visible from a distance of 48 inches. Remove and replace frames with damaged finish that cannot be satisfactorily repaired.

END OF SECTION 081216

SECTION 081416 - FLUSH WOOD DOORS

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. Solid-core doors with wood-veneer faces.
2. Factory finishing flush wood doors.
3. Factory machining for hardware.

B. Related Sections:

1. Division 06 Section "Interior Architectural Woodwork" for requirements for veneers from the same flitches for both flush wood doors and wood paneling.
2. Division 08 Section "Glazing" for glass view panels in flush wood doors.

1.3 SUBMITTALS

- A. Shop Drawings: Indicate location, size, and hand of each door ; elevation of each kind of door ; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.
- B. Warranty: Sample of special warranty.
- C. Samples: Door finish (stain) sample for review and approval.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain flush wood doors from single manufacturer.
- B. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, "Architectural Wood Flush Doors."
- C. Preinstallation Conference: Conduct conference at Project site.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in cardboard cartons and wrap bundles of doors in plastic sheeting.



- C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

#### 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

#### 1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
    - b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
  - 2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
  - 3. Warranty Period for Solid-Core Interior Doors: Life of installation.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide the following:
  - 1. Marshfield Door Systems, Inc.

#### 2.2 DOOR CONSTRUCTION, GENERAL

- A. WDMA I.S.1-A Performance Grade: Heavy Duty.
- B. 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.

#### 2.3 VENEERED-FACED DOORS FOR TRANSPARENT FINISH

- A. Interior Solid-Core Doors D2 and D3:
  - 1. Grade: Custom (Grade A faces).
  - 2. Species: Select white maple.
  - 3. Cut: Plain sliced (flat sliced).
  - 4. Match between Veneer Leaves: Pleasing match.

5. Assembly of Veneer Leaves on Door Faces: Center-balance match.
6. Room Match: Provide door faces of compatible color and grain within each separate room or area of building.
7. Exposed Vertical and Top Edges: Same species as faces.
8. Core: Typical PC- Particle board.
9. Construction: Solid core.
10. WDMA I.S.1-A Performance Grade: Heavy Duty.

#### 2.4 LOUVERS AND LIGHT FRAMES

- A. Wood Louvers: Door manufacturer's standard solid-wood louvers unless otherwise indicated.
  1. Wood Species: Same species as door faces.
- B. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads as follows unless otherwise indicated.
  1. Wood Species: Same species as door faces.
  2. Profile: Manufacturer's standard shape.
  3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.

#### 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 requirements in NFPA 80 for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.
  1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
  2. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.

#### 2.6 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. Finish doors at factory.
- C. Finish doors at factory that are indicated to receive transparent finish. Field finish doors indicated to receive opaque finish.
- D. Finish doors at factory where indicated in schedules or on Drawings as factory finished.

- E. Transparent Finish:
  - 1. Grade: Custom.
  - 2. Finish: WDMA TR-6 catalyzed polyurethane.
  - 3. Stain color: as indicated on drawings.
  - 4. Effect: Open-grain finish.
  - 5. Sheen: Satin.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine doors and installed door frames before hanging doors.
  - 1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
  - 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Hardware: For installation, see Division 08 Section "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.
  - 1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.
- 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.
  - 2. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.
  - 3. Bevel fire-rated doors 1/8 inch in 2 inches at lock edge; trim stiles and rails only to extent permitted by labeling agency.
- 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.

### 3.3 ADJUSTING

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- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

## SECTION 083113 - ACCESS DOORS AND FRAMES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Access doors and frames for walls and ceilings.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of access door and frame indicated. Include construction details, materials, individual components and profiles, and finishes.
- B. Shop Drawings: Show fabrication and installation details of access doors and frames for each type of substrate. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each door face material, at least 3 by 5 inches in size, in specified finish.
- D. Access Door and Frame Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

#### 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain access door(s) and frame(s) through one source from a single manufacturer.
- B. Size Variations: Obtain Architect's acceptance of manufacturer's standard-size units, which may vary slightly from sizes indicated.

#### 1.5 COORDINATION

- A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed plumbing, mechanical, or other concealed work, and indicate in the schedule specified in "Submittals" Article.

## PART 2 - PRODUCTS

### 2.1 STEEL MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Cold-Rolled Steel Sheets: ASTM A 366/A 366M, Commercial Steel (CS), or ASTM A 620/A 620M, Drawing Steel (DS), Type B; stretcher-leveled standard of flatness; with minimum thickness indicated representing specified nominal thickness according to ASTM A 568/A 568M. Electrolytic zinc-coated steel sheet, complying with ASTM A 591/A 591M, Class C coating, may be substituted at fabricator's option.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS) with A60 zinc-iron-alloy (galvannealed) coating or G60 mill-phosphatized zinc coating; stretcher-leveled standard of flatness; with minimum thickness indicated representing specified thickness according to ASTM A 924/A 924M. Provide in bathrooms only.
- D. Steel Finishes: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
  - 1. Surface Preparation for Steel Sheet: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
  - 2. Surface Preparation for Metallic-Coated Steel Sheet: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.
  - 3. Factory-Primed Finish: Apply shop primer immediately after cleaning and pretreating. Comply with requirements of Section 09912- Painting.
- E. Drywall Beads: Edge trim formed from 0.0299-inch zinc-coated steel sheet formed to receive joint compound and in size to suit thickness of gypsum board.

### 2.2 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Babcock-Davis; A Cierra Products Co.
  - 2. J. L. Industries, Inc.
  - 3. Larsen's Manufacturing Company.
  - 4. Milcor Inc.
  - 5. Nystrom, Inc.
- B. Flush Access Doors and Frames with Exposed Trim: Fabricated from metallic-coated steel sheet. Provide in dryer room.

1. Locations: Wall surfaces.
2. Door: Minimum 0.060-inch- thick sheet metal, set flush with surrounding flush surfaces.
3. Frame: Minimum 0.060-inch- thick sheet metal with 1-inch- thin as possible surface-mounted trim.
4. Hinges: Continuous piano hinge.
5. Latch: Self-latching bolt operated by knurled knob with interior release.
6. Lock: flush key operated latch bolt with interior release Mortise cylinder.

- a. Lock Preparation: Prepare door panel to accept cylinder specified in Division 8 Section "Door Hardware"

- C. Exterior Flush Access Doors and Frames with Exposed Trim: Weatherproof with extruded door gasket.

1. Locations: Ceiling surfaces.
2. Door: Minimum 0.040-inch-thick, metallic-coated steel sheet; flush panel construction with manufacturer's standard 2-inch- thick fiberglass insulation.
3. Frame: Minimum 0.060-inch-thick extruded aluminum.
4. Hinges: Continuous piano, zinc plated.
5. Lock: flush key operated latch bolt with interior release. Mortise cylinder.

## 2.3 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. Steel Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.
1. Exposed Flanges: To match the perimeter of frame.
  2. Provide mounting holes in frames for attachment of units to metal framing.
- D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
1. For cylinder lock, furnish two keys per lock and key all locks alike.

## 2.4 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.

## 2.5 STEEL FINISHES

- A. Surface Preparation: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed metal fabrications:
  - 1. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."
- B. Apply shop primer to uncoated surfaces of metal fabrications. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Advise installers of other work about specific requirements relating to access door and floor door installation, including sizes of openings to receive access door and frame, as well as locations of supports, inserts, and anchoring devices.

### 3.2 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.

### 3.3 ADJUSTING AND CLEANING

- 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 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
  - 1. Exterior and interior storefront framing.
  - 2. Storefront framing for window walls.
  - 3. Exterior and interior manual-swing entrance doors and door-frame units.

1.3 DEFINITIONS

- A. ADA/ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disability Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities."

1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:
  - 1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
  - 2. Dimensional tolerances of building frame and other adjacent construction.
  - 3. Failure includes the following:
    - a. Deflection exceeding specified limits.
    - b. Thermal stresses transferring to building structure.
    - c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
    - d. Noise or vibration created by wind and by thermal and structural movements.
    - e. Loosening or weakening of fasteners, attachments, and other components.
    - f. Sealant failure.
    - g. Failure of operating units.
- B. Structural Loads:
  - 1. Wind Loads: As indicated on Drawings.
  - 2. Seismic Loads: As indicated on Drawings.

- C. Deflection of Framing Members:
1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
  2. Deflection Parallel to Glazing Plane: Limited to L/360 of clear span or 1/8 inch, whichever is smaller.
- D. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:
1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
  2. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
  3. Test Durations: As required by design wind velocity, but not fewer than 10 seconds.
- E. Windborne-Debris-Impact-Resistance Performance: Provide aluminum-framed systems that pass missile-impact and cyclic-pressure tests when tested according to ASTM E 1886 and testing information in ASTM E 1996.
1. Large-Missile Impact: For aluminum-framed systems located within 30 feet of grade.
  2. Small-Missile Impact: For aluminum-framed systems located more than 30 feet above grade.
- F. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft.
- G. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft.
- H. Water Penetration under Dynamic Pressure: Provide aluminum-framed systems that do not evidence water leakage through fixed glazing and framing areas when tested according to AAMA 501.1 under dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft.
1. Maximum Water Leakage: No uncontrolled water penetrating aluminum-framed systems or water appearing on systems' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters that is drained to exterior and water that cannot damage adjacent materials or finishes.
- I. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation 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. Test Performance: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.
    - a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F.
    - b. Low Exterior Ambient-Air Temperature: 0 deg F.

3. Interior Ambient-Air Temperature: 75 deg F.
- J. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 53 when tested according to AAMA 1503.
- K. Thermal Conductance: Provide aluminum-framed systems with fixed glazing and framing areas having an average U-factor of not more than 0.57 Btu/sq. ft. x h x deg F when tested according to AAMA 1503.
- L. Sound Transmission: Provide aluminum-framed systems with fixed glazing and framing areas having the following sound-transmission characteristics:
  1. Sound Transmission Class (STC): Minimum 35 STC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413.
  2. Outdoor-Indoor Transmission Class (OITC): Minimum 34 OITC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 1332.

#### 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum framed systems.
- B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
  1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
  2. For entrance doors, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.
- C. Other Action Submittals:
  1. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.
- D. Warranties: Sample of special warranties.

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.
- C. Engineering Responsibility: Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.
- D. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. 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. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.

1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.

E. Source Limitations for Aluminum-Framed Systems: Obtain from single source from single manufacturer.

F. Welding Qualifications: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code - Aluminum."

G. Preinstallation Conference: Conduct conference at Project site.

#### 1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

#### 1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

- a. Structural failures including, but not limited to, excessive deflection.
- b. Noise or vibration caused by thermal movements.
- c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
- d. Water leakage through fixed glazing and framing areas.
- e. Failure of operating components.

2. Warranty Period: 5 years from date of Substantial Completion.

B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.

1. Warranty Period: 5 years from date of Substantial Completion.

#### 1.9 MAINTENANCE SERVICE

A. Entrance Door Hardware:

1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.

2. Initial Maintenance Service: Beginning at Substantial Completion, provide six months' full maintenance by skilled employees of entrance door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication,

cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Provide parts and supplies the same as those used in the manufacture and installation of original equipment.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Provide the following:
1. Kawneer North America; an Alcoa company.

### 2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
1. Sheet and Plate: ASTM B 209.
  2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
  3. Extruded Structural Pipe and Tubes: ASTM B 429.
  4. Structural Profiles: ASTM B 308/B 308M.
  5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.
- B. 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.
1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
  2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
  3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

### 2.3 FRAMING SYSTEMS

- A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
1. Construction: Thermally improved.
  2. Glazing System: Retained mechanically with gaskets on four sides.
  3. Glazing Plane: Center.
- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
  2. Reinforce members as required to receive fastener threads.
  3. Use exposed fasteners with countersunk Phillips screw heads, fabricated from stainless steel.

- D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts, complying with ASTM A 123/A 123M or ASTM A 153/A 153M.
- E. Concealed F lashing: Dead-soft, 0.018-inch-thick stainless steel, ASTM A 240/A 240M of type recommended by manufacturer.
- F. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.

## 2.4 GLAZING SYSTEMS

- A. Glazing: As specified in Division 08 Section "Glazing."
- B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.
- C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.
- D. Glazing Sealants.

## 2.5 ENTRANCE DOOR SYSTEMS

- A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.
  - 1. Door Construction: 1-3/4-inch overall thickness, with minimum 0.125-inch-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 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.
- B. Entrance Door Hardware: As specified in Division 08 Section "Door Hardware."

## 2.6 ACCESSORY MATERIALS

- A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 07 Section "Joint Sealants."
- B. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil thickness per coat.

## 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. Framing Members, General: 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. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
  - 4. Physical and thermal isolation of glazing from framing members.
  - 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
  - 6. Provisions for field replacement of glazing from interior for vision glass and exterior for spandrel glazing or metal panels.
  - 7. 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. Storefront Framing: Fabricate components for assembly using shear-block system.
- F. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
- G. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
- H. 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.
- I. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

## 2.8 ALUMINUM FINISHES

- A. Finish: KAWNEER Permadize Finish- Sterling Gray.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 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.
6. Seal joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

D. Set continuous sill members and flashing in full sealant bed as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.

E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.

F. Install glazing as specified in Division 08 Section "Glazing."

G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

1. 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.

H. Install perimeter joint sealants as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.

### 3.3 ERECTION TOLERANCES

A. Install aluminum-framed systems to comply with the following maximum erection tolerances:

1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet; 1/4 inch over total length.
2. Alignment:
  - a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch.
  - b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch.

B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch.

### 3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections.



- B. Testing Services: Testing and inspecting of representative areas to determine compliance of installed systems with specified requirements shall take place as follows. Do not proceed with installation of the next area until test results for previously completed areas show compliance with requirements.
  - 1. Structural-Sealant Glazing Inspection: After installation of aluminum-framed systems is complete, structural-sealant glazing shall be inspected and evaluated according to recommendations in ASTM C 1401.
  - 2. 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. Test Area: A minimum area of 75 feet by 1 story of aluminum-framed systems.
- C. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- E. Aluminum-framed assemblies will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.

### 3.5 ADJUSTING

- A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.

END OF SECTION 084113

## SECTION 084413 - GLAZED ALUMINUM CURTAIN WALLS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes conventionally glazed aluminum curtain walls installed as stick assemblies.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Comply with performance requirements specified, as determined by preconstruction testing of manufacturer's standard glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
  - 1. Glazed aluminum curtain walls shall withstand movements of supporting structure as indicated 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.
- B. Delegated Design: Design glazed aluminum curtain walls, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Structural Loads:
  - 1. Wind Loads: As indicated on Drawing S-001
    - a. Basic Wind Speed: As indicated on Drawing S-001
    - b. Importance Factor: As indicated on Drawing S-001
    - c. Exposure Category: As indicated on Drawing S-001
  - 2. Seismic Loads: As indicated on Drawing S-001.
- D. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:
  - 1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
  - 2. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
  - 3. Test Durations: As required by design wind velocity, but not fewer than 10 seconds.

- E. 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  $L/175$  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, whichever is less.
  2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch.
- F. Seismic Performance: Glazed aluminum curtain walls shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
1. Component Importance Factor is 1.25.
- G. Story Drift: Provide aluminum-framed systems that accommodate design displacement of adjacent stories indicated.
1. Design Displacement: 1/2 inch.
  2. Test Performance: Meet criteria for passing, based on building occupancy type, when tested according to AAMA 501.4 at design displacement and 1.5 times the design displacement.
- H. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..
1. Maximum Water Leakage: No uncontrolled water penetrating aluminum-framed systems or water appearing on systems' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters that is drained to exterior and water that cannot damage adjacent materials or finishes.
- I. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation 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. Test Interior Ambient-Air Temperature: 75 deg F.
  3. Test Performance: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.
- J. Energy Performance: Glazed aluminum curtain walls shall have certified and labeled energy performance ratings in accordance with NFRC.
1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.41 Btu/sq. ft. x h x deg F 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 0.38 as determined according to NFRC 200.
- K. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 1.57 lbf/sq. ft..
1. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC- certified condensation resistance rating of no less than 61 as determined according to NFRC 1503.

### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For glazed aluminum curtain walls. Include plans, elevations, sections, full-size details, and attachments to other work.
1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
  2. Include full-size isometric details of each vertical-to-horizontal intersection of glazed aluminum curtain walls, showing the following:
    - a. Joinery, including concealed welds.
    - b. Anchorage.
    - c. Expansion provisions.
    - d. Glazing.
    - e. Flashing and drainage.
  3. Include laboratory mockup Shop Drawings, prepared by a qualified preconstruction testing agency, showing details of laboratory mockup.
    - a. Resubmit Shop Drawings with changes made to glazed aluminum curtain walls to successfully complete preconstruction testing.
- C. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, including corner assemblies, made from 12-inch lengths of full-size components and showing details of the following:
  1. Joinery, including concealed welds.
  2. Anchorage.
  3. Expansion provisions.
  4. Glazing.
  5. Flashing and drainage.
- D. Delegated-Design Submittal: For glazed aluminum curtain walls indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Qualification Data: For qualified Installer and preconstruction testing agency.

F. Energy Performance Certificates: For glazed aluminum curtain walls, accessories, and components, from manufacturer.

1. Basis for Certification: NFRC-certified energy performance values for each glazed aluminum curtain wall.

#### 1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer capable of fabricating glazed aluminum curtain walls that meet or exceed energy performance requirements indicated and of documenting this performance by certification, labeling, and inclusion in lists.

B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

C. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.

D. 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 revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.

E. Source Limitations: Obtain glazed aluminum curtain wall system and aluminum-framed entrances and storefront system from single source from single manufacturer.

F. Energy Performance Standards: Comply with NFRC form minimum standards of energy performance, materials, components, accessories, and fabrication. Comply with more stringent requirements if indicated.

#### 1.5 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for glazed aluminum curtain walls by field measurements before fabrication and indicate measurements on Shop Drawings.

#### 1.6 WARRANTY

A. Special Assembly Warranty: Standard form in which manufacturer agrees to repair or replace components of glazed aluminum curtain walls that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.

b. Noise or vibration created by wind and thermal and structural movements.

- c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  - d. Water penetration through fixed glazing and framing areas.
  - e. Failure of operating components.
2. Warranty Period: 1 year 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: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Kawneer North America; an Alcoa company; 1600 Wall System® 3 or a comparable product by another manufacturer.

### 2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
  1. Sheet and Plate: ASTM B 209.
  2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
  3. Extruded Structural Pipe and Tubes: ASTM B 429.
  4. Structural Profiles: ASTM B 308/B 308M.
- B. 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.
  1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
  2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
  3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

### 2.3 FRAMING

- A. Framing Members: Manufacturer's standard 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: Front.

- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
  - 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
  - 2. Reinforce members as required to receive fastener threads.
  - 3. Where it is not possible to use concealed fasteners, use exposed fasteners with countersunk Phillips screw heads, fabricated from 300 series stainless steel.
- D. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
  - 1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.
- E. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- F. Framing Sealants: Comply with requirements of Division 07 Section "Joint Sealants."

## 2.4 GLAZING

- A. Glazing: Comply with Division 08 Section "Glazing."
- B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

## 2.5 ACCESSORY MATERIALS

- A. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

## 2.6 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. 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.
- C. Curtain-Wall Framing: Fabricate components for assembly using shear-block system.
- D. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

## 2.7 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas, with Installer present, 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.
  1. Proceeding with installation constitutes acceptance and suitability of substrates and conditions.

### 3.2 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 joints watertight unless otherwise indicated.
- B. 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 or installing nonconductive spacers as recommended by manufacturer for this purpose.
  2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
- D. Install components plumb and true in alignment with established lines and grades.



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- E. Install glazing as specified in Division 08 Section "Glazing."

### 3.3 ERECTION TOLERANCES

- A. Erection Tolerances: Install glazed aluminum curtain walls to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
3. Alignment:
  - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
  - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
  - c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.
4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

END OF SECTION 084413

SECTION 085113 - ALUMINUM WINDOWS

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 fixed aluminum-framed windows for exterior locations.
- B. Related Sections include the following:
  - 1. Division 08 Section "Aluminum-Framed Entrances and Storefronts" for coordinating finish among aluminum fenestration units.
  - 2. Division 08 Section "Glazed Aluminum Curtain Walls" for incorporating aluminum windows into glazed curtain walls and for coordinating finish among aluminum fenestration units.

1.3 DEFINITIONS

- A. Performance class designations according to AAMA/WDMA 101/I.S.2/NAFS:
  - 1. AW: Architectural.
- B. Performance grade number according to AAMA/WDMA 101/I.S.2/NAFS:
  - 1. Design pressure number in pounds force per square foot used to determine the structural test pressure and water test pressure.
- C. Structural Test Pressure: For uniform load structural test, is equivalent to 150 percent of the design pressure.
- D. Minimum Test Size: Smallest size permitted for performance class (gateway test size). Products must be tested at minimum test size or at a size larger than minimum test size to comply with requirements for performance class.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide aluminum windows capable of complying with performance requirements indicated, based on testing manufacturer's windows that are representative of those specified, and that are of minimum test size indicated below:
  - 1. Size required by AAMA/WDMA 101/I.S.2/NAFS for gateway performance.
  - 2. Size indicated on Drawings.

- B. Structural Performance: Provide aluminum windows capable of withstanding the effects of the following loads, based on testing units representative of those indicated for Project that pass AAMA/WDMA 101/I.S.2/NAFS, Uniform Load Structural Test:
1. Design Wind Loads: Determine design wind loads applicable to Project from basic wind speed indicated in miles per hour at 33 feet above grade, according to ASCE 7, Section 6.5, "Method 2-Analytical Procedure," based on mean roof heights above grade indicated on Drawings. Use basic wind speed importance factor and exposure category indicated on drawings.
  2. Deflection: Design glass framing system to limit lateral deflections of glass edges to less than 1/175 of glass-edge length or 3/4 in, whichever is less, at design pressure based on testing performed according to AAMA/WDMA 101/I.S.2/NAFS, Uniform Load Deflection Test or structural computations.
- C. Windborne-Debris Resistance: Provide glazed windows capable of resisting impact from windborne debris, based on the pass/fail criteria as determined from testing glazed windows identical to those specified, according to ASTM E 1886 and testing information in ASTM E 1996 and requirements of authorities having jurisdiction.
- D. Thermal Movements: Provide aluminum windows, including anchorage, that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation 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.

#### 1.5 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions for each type of aluminum window indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, hardware, attachments to other work, operational clearances, installation details, and the following:
1. Joinery details.
  2. Expansion provisions.
  3. Thermal-break details.
  4. Glazing details.
- C. Maintenance Data: For finishes to include in maintenance manuals.
- D. Warranty: Special warranty specified in this Section.

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An installer acceptable to aluminum window manufacturer for installation of units required for this Project.
1. Installer's responsibilities include providing professional engineering services needed to assume engineering responsibility.

2. Engineering Responsibility: Preparation of data for aluminum windows, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by inclusion in lists and by labels, test reports, and calculations.
  - C. Source Limitations: Obtain aluminum windows through one source from a single manufacturer.
  - D. Product Options: Information on Drawings and in Specifications establishes requirements for aluminum windows' aesthetic effects and performance characteristics. 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. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
  - E. Fenestration Standard: Comply with AAMA/WDMA 101/I.S.2/NAFS, "North American Fenestration Standard Voluntary Performance Specification for Windows, Skylights and Glass Doors," for definitions and minimum standards of performance, materials, components, accessories, and fabrication. Comply with more stringent requirements if indicated.
    1. Provide AAMA-certified aluminum windows with an attached label.
  - F. Glazing Publications: Comply with published recommendations of glass manufacturers and with GANA's "Glazing Manual" unless more stringent requirements are indicated.
  - G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to aluminum windows including, but not limited to, the following:
    1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
    2. Review and discuss the finishing of aluminum windows that is required to be coordinated with the finishing of other aluminum work for color and finish matching.
    3. Review, discuss, and coordinate the interrelationship of aluminum windows with other exterior wall components. Include provisions for structural anchorage, glazing, flashing, weeping, sealants, and protection of finishes.
    4. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.
    5. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

## 1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify aluminum window openings by field measurements before fabrication and indicate measurements on Shop Drawings.
  1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating aluminum windows without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to established dimensions.

## 1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace aluminum 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, water leakage, air infiltration, or condensation.
    - c. Faulty operation of movable sash and hardware.
    - d. Deterioration of metals, other materials, and metal finishes beyond normal weathering.
    - e. Failure of insulating glass.
  2. Warranty Period:
    - a. Window: 5 years from date of Substantial Completion.
    - b. Glazing: 5 years from date of Substantial Completion.
    - c. Metal Finish: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers:
1. Kawneer; an Alcoa Company.

### 2.2 WINDOWS B, C, D and E.

- A. Window Type: Fixed with spandrel transom panel.
- B. AAMA/WDMA Performance Requirements: Provide aluminum windows of performance indicated that comply with AAMA/WDMA 101/I.S.2/NAFS unless more stringent performance requirements are indicated.
1. Performance Class and Grade: As indicated.
- C. Thermal Transmittance: Provide aluminum windows with a whole-window, U-factor maximum indicated at 15-mph exterior wind velocity and winter condition temperatures when tested according to ASTM E 1423.
1. U-Factor: 0.40 Btu/sq. ft. x h x deg F or less.
- D. Solar Heat-Gain Coefficient (SHGC): Provide aluminum windows with a whole-window SHGC maximum of 0.50, determined according to NFRC 200 procedures.

### 2.3 GLAZING

- A. Glass and Glazing Materials: Refer to Division 08 Section "Glazing" for glass units and glazing requirements applicable to glazed aluminum window units.

## 2.4 FABRICATION

- A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.
- B. Fabricate aluminum windows that are reglazable without dismantling sash or transom framing.
- C. Thermally Improved Construction: Fabricate aluminum windows with an integral, concealed, low-conductance thermal barrier; located between exterior materials and window members exposed on interior side; in a manner that eliminates direct metal-to-metal contact.
  - 1. Provide thermal barriers tested according to AAMA 505; determine the allowable design shear flow per the appendix in AAMA 505.
- D. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.
- E. Provide water-shed members above side-hinged ventilators and similar lines of natural water penetration.
- F. Glazing Stops: Provide snap-on glazing stops coordinated with Division 08 Section "Glazing" and glazing system indicated. Provide glazing stops to match sash and ventilator frames.

## 2.5 FINISHES, GENERAL

- A. Comply with NAAAM'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: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.6 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
  - 1. Finish: KAWNEER Permadize Finish- Sterling Gray.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work. Verify rough opening dimensions, levelness of sill plate, and operational clearances. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure a coordinated, weathertight window installation.

1. Masonry Surfaces: Visibly dry and free of excess mortar, sand, and other construction debris.
2. Metal Surfaces: Dry; clean; free of grease, oil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing windows.
- B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.
- C. Set sill members in full bed of sealant for weathertight construction.
- D. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.
- E. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

### 3.3 ADJUSTING, CLEANING, AND PROTECTION

- A. 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.
- B. Clean aluminum surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
- C. Protect window surfaces from contact with contaminating substances resulting from construction operations. In addition, monitor window surfaces adjacent to and below exterior concrete and masonry surfaces during construction for presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written recommendations.

END OF SECTION 085113

SECTION 087100 - DOOR HARDWARE

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. Commercial door hardware for the following:
    - a. Swinging doors.
    - b. Other doors to the extent indicated.
  - 2. Cylinders for doors specified in other Sections.
- B. Related Sections include the following:
  - 1. Division 08 Section "Hollow Metal Doors and Frames".
  - 2. Division 08 Section "Aluminum Frames" for door silencers provided as part of frames.
  - 3. Division 08 Section "Access Doors and Frames" for access door hardware, including cylinders.
  - 4. Division 08 Section "Aluminum-Framed Entrances and Storefronts" for entrance door hardware, including cylinders.
- C. Products furnished, but not installed, under this Section include the following. Coordinating, purchasing, delivering, and scheduling remain requirements of this Section.

1.3 SUBMITTALS

- A. Product Data: Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware and keying schedule.
- C. Warranty: Special warranty specified in this Section.
- D. Other Action Submittals:
  - 1. Door Hardware Sets: Prepared by or under the supervision of Architectural Hardware Consultant, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final door hardware sets 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, and material of each door and frame.
- 2) Type, style, function, size, quantity, and finish of each door hardware item. Include description and function of each lockset and exit device.
- 3) Complete designations of every item required for each door or opening including name and manufacturer.
- 4) Fastenings and other pertinent information.
- 5) Location of each door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
- 6) Explanation of abbreviations, symbols, and codes contained in schedule.
- 7) Mounting locations for door hardware.
- 8) Door and frame sizes and materials.
- 9) List of related door devices specified in other Sections for each door and frame.

2. Keying Schedule: Prepared by or under the supervision of Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by lock manufacturer.
  1. Installer's responsibilities include supplying and installing door hardware and providing a qualified Architectural Hardware Consultant available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.
  2. Installer shall have warehousing facilities in Project's vicinity.
  3. Scheduling Responsibility: Preparation of door hardware and keying schedules.
- B. Architectural Hardware Consultant Qualifications: A person who is currently certified by DHI as an Architectural Hardware Consultant and who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project.
- C. Source Limitations: Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
- B. Tag each item or package separately with identification related to the final door hardware sets, and include basic installation instructions, templates, and necessary fasteners with each item or package.
- C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

#### 1.6 COORDINATION

- A. Coordinate layout and installation of recessed pivots with floor construction. Cast anchoring inserts in concrete. Concrete, reinforcement, and formwork requirements are specified in Division 03.

- B. Templates: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

## 1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including excessive deflection, cracking, or breakage.
    - b. Faulty operation of operators and door hardware.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
  - 2. Warranty Period: Five years from date of Substantial Completion.

## 1.8 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
- B. Maintenance Service: Beginning at Substantial Completion, provide six months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door hardware operation. Provide parts and supplies same as those used in the manufacture and installation of original products.

## PART 2 - PRODUCTS

### 2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware as indicated on drawings.
  - 1. 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.

### 2.2 HINGES, GENERAL

- A. Quantity: Provide the following, unless otherwise indicated:
  - 1. Three Hinges: For doors with heights 61 to 90 inches.
- B. Template Requirements: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.
- C. Hinge Weight: Unless otherwise indicated, provide the following:

1. Entrance Doors: Heavy-weight hinges.
2. Doors with Closers: Antifriction-bearing hinges.
3. Interior Doors: Standard-weight hinges.

D. Hinge Base Metal: Unless otherwise indicated, provide the following:

1. Exterior Hinges: Stainless steel, with stainless-steel pin.
2. Interior Hinges: Stainless steel, with stainless-steel pin.

E. Hinge Options: Where indicated in door hardware sets or on Drawings:

1. Corners: 1/4-inch radius.

F. Fasteners: Comply with the following:

1. Machine Screws: For metal doors and frames. Install into drilled and tapped holes.
2. Wood Screws: For wood doors and frames.
3. Screws: Phillips flat-head. Finish screw heads to match surface of hinges.

## 2.3 HINGES

A. Butts and Hinges: BHMA A156.1. Listed under Category A in BHMA's "Certified Product Directory."

B. Template Hinge Dimensions: BHMA A156.7.

## 2.4 LOCKS AND LATCHES, GENERAL

A. Accessibility Requirements: Where indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)" or ANSI A 117.1 based upon local regulations.

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.

B. Latches and Locks for Means of Egress Doors: Comply with NFPA 101. Latches shall not require more than 15 lbf to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.

C. Lock Trim:

1. Levers: Forged.
2. Escutcheons (Roses): Wrought.
3. Dummy Trim: Match lever lock trim and escutcheons.
4. Lockset Designs: Provide design indicated on Drawings or, if sets are provided by another manufacturer, provide designs that match those designated.

D. Backset: 70 mm, unless otherwise indicated.

E. Strikes: Manufacturer's standard strike with strike box for each latchbolt or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, and as follows:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.

3. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.

## 2.5 MECHANICAL LOCKS AND LATCHES

- A. Lock Functions: Function numbers and descriptions indicated in door hardware sets comply with the following:
  1. Bored Locks: BHMA A156.2.

## 2.6 AUXILIARY LOCKS AND LATCHES

- A. Push-Button Combination Locks: BHMA A156.5, Grade 1 for cylindrical locks.

## 2.7 SELF-CONTAINED ELECTRONIC LOCKS

- A. General: Internal, battery-powered, self-contained electronic locks; consisting of complete lockset, motor-driven lock mechanism, and actuating device; enclosed in zinc-dichromate-plated, wrought-steel case. Provide key override, low-battery detection and warning, LED status indicators, and ability to program at the lock; type and function indicated.
  1. Actuating Device: Digital keypad.
  2. Faceplate Material: Stainless steel.
  3. Trim: Lever.

## 2.8 EXIT DEVICES

- A. Exit Devices: BHMA A156.3. Listed under Category G in BHMA's "Certified Product Directory."
- B. Accessibility Requirements: Where handles, pulls, latches, locks, and other operating devices are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)" Or ANSI A117.1 based on local jurisdiction.
  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.
- C. Exit Devices for Means of Egress Doors: Comply with NFPA 101. Exit devices shall not require more than 15 lbf to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.
- D. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.
- E. Outside Trim: Lever with cylinder; material and finish to match locksets, unless otherwise indicated.
  1. Match design for locksets and latchsets, unless otherwise indicated.
- F. Through Bolts: For exit devices and trim on metal doors.

## 2.9 LOCK CYLINDERS

- A. Standard Lock Cylinders: BHMA A156.5, Grade 1.
- B. Cylinders: Manufacturer's standard tumbler type, constructed from brass or bronze, stainless steel, or nickel silver, and complying with the following:
  - 1. Number of Pins: Five.
  - 2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
- C. Permanent Cores: Manufacturer's standard; finish face to match lockset; complying with the following:
  - 1. Interchangeable Cores: Core insert, removable by use of a special key; usable with other manufacturers' cylinders.
- D. Construction Keying: Comply with the following:
  - 1. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.
- E. Manufacturer: Same manufacturer as for locks and latches.

## 2.10 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference, and as follows:
  - 1. Great-Grand Master Key System: Cylinders are operated by a change key, a master key, a grand master key, and a great-grand master key.
- B. Keys: Nickel silver.
  - 1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
    - a. Notation: Information to be furnished by Owner.
  - 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.

## 2.11 CLOSERS

- A. Accessibility Requirements: Where handles, pulls, latches, locks, and other operating devices are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)" or ANSI A117.1 based on local regulations.
  - 1. Comply with the following maximum opening-force requirements:
    - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.

- B. Door Closers for Means of Egress Doors: Comply with NFPA 101. Door closers shall not require more than 30 lbf to set door in motion and not more than 15 lbf to open door to minimum required width.
- C. Size of Units: Unless otherwise indicated, 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.
- D. Concealed Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves. Comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force. See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers. Retain one of two subparagraphs and list of manufacturers below. See Division 01 Section "Product Requirements."

## 2.12 STOPS AND HOLDERS

- A. Stops and Bumpers: BHMA A156.16, Grade 1.
  - 1. Provide floor stops for doors unless wall or other type stops are scheduled or indicated. Do not mount floor stops where they will impede traffic. Where floor or wall stops are not appropriate, provide overhead holders.
- B. Silencers for Metal Door Frames: BHMA A156.16, Grade 1; neoprene or rubber, minimum diameter 1/2 inch; fabricated for drilled-in application to frame.

## 2.13 DOOR GASKETING

- A. Standard: BHMA A156.22. Listed under Category J in BHMA's "Certified Product Directory."
- B. General: Provide continuous weather-strip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated or scheduled. Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.
  - 1. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- C. Air Leakage: Not to exceed 0.50 cfm per foot of crack length for gasketing other than for smoke control, as tested according to ASTM E 283.
- D. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- E. Gasketing Materials: ASTM D 2000 and AAMA 701/702.

## 2.14 FABRICATION

- A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by Architect.
  - 1. Manufacturer's identification is permitted on rim of lock cylinders only.

- B. Base Metals: Produce door hardware units of base metal, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18. Do not furnish manufacturer's standard materials or forming methods if different from specified standard.
- C. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to 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. Spacers or Sex Bolts: For through bolting of hollow-metal doors.

## 2.15 FINISHES

- A. Standard: BHMA A156.18, as indicated in door hardware sets.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Steel Doors and Frames: Comply with DHI A115 Series.
  - 1. Surface-Applied Door Hardware: Drill and tap doors and frames according to ANSI A250.6.

### 3.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights indicated as follows unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 09 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

### 3.4 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.

1. Independent Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

### 3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Door Closers: Unless otherwise required by authorities having jurisdiction, adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.

B. Occupancy Adjustment: Approximately six months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust, including adjusting operating forces, each item of door hardware as necessary to ensure function of doors and door hardware.

### 3.6 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

### 3.7 DEMONSTRATION



NFCU

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Division 01 Section "Demonstration and Training."

3.8 HARDWARE SETS

- A. As indicated on drawings.

END OF SECTION 087100

SECTION 088000 - GLAZING

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 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. Storefront framing.
  - 4. Interior borrowed lites.
- B. Related Sections:
  - 1. Division 08 Section "Aluminum Framed Entrances."

1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. Interspace: Space between lites of an insulating-glass unit.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss of glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Delegated Design: Design glass, including comprehensive engineering analysis according to ICC's 2006 International Building Code by a qualified professional engineer, using the following design criteria:
  - 1. Design Wind Pressures: As indicated on Drawings.
  - 2. Design Snow Loads: As indicated on Drawings.
  - 3. 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.
  - 4. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.

5. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

#### 1.5 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.

#### 1.6 SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Product Certificates: For glass and glazing products, from manufacturer.

C. Warranties: Sample of special warranties.

#### 1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.

B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

C. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

D. Source Limitations for Glass: Obtain from single source from single manufacturer.

E. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

F. 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 "Laminated Glazing Reference Manual" and GANA's "Glazing Manual."

2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR-A7, "Sloped Glazing Guidelines."

3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."

4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

G. 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. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

- H. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

#### 1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are out

- C. Windborne-Debris-Impact Resistance: Pass test requirements in ASTM E1996 for wind zone indicated on sheet S-001.
- D. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, .

## 2.2 GLASS PRODUCTS

- A. Heat strengthened glass: As indicated on glass schedule.
  - B. Annealed Glass: As indicated on glass schedule.
  - C. Spandrel Glass: As indicated on glass schedule.
  - D. Tempered Glass: As indicated on glass schedule.
  - E. Laminated Glass: As indicated on glass schedule.
1. Products: Subject to compliance with requirements, provide the following, but are not limited to the following:
    - a. Zeledyne: Versalux  
5555 South 129<sup>th</sup> East Ave.  
Tulsa, OK 74135  
800-331-2607

## 2.3 LAMINATED GLASS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following, but are not limited to, the following:
  1. Zeledyne:Versalux.
- B. Laminated Glass: ASTM C 1172, and complying with testing requirements in 16 CFR 1201 for Category II materials, and with other requirements specified. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
  1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written recommendations.
  2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
  3. Interlayer Color: Clear unless otherwise indicated.
- C. Windborne-Debris-Impact-Resistant Laminated Glass: ASTM C 1172, and complying with testing requirements in 16 CFR 1201 for Category II materials, with "Windborne-Debris-Impact Resistance" Paragraph in "Glass Products, General" Article, and with other requirements specified. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
  1. Construction: Laminate glass with one of the following to comply with interlayer manufacturer's written recommendations:
    - a. Polyvinyl butyral interlayer.
    - b. Polyvinyl butyral interlayers reinforced with polyethylene terephthalate film.
    - c. Ionoplast interlayer.
    - d. Cast-in-place and cured-transparent-resin interlayer.

- e. Cast-in-place and cured-transparent-resin interlayer reinforced with polyethylene terephthalate film.
  - 2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
  - 3. Interlayer Color: Clear unless otherwise indicated.
- D. Glass: Comply with applicable requirements in "Glass Products" Article as indicated by designations in "Laminated-Glass Types" Article.

## 2.4 INSULATING GLASS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- 1. Zeledyne: Versalux
- 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, with manufacturer's standard primary and secondary.
  - 2. Spacer: Aluminum with mill or clear anodic finish.
  - 3. Desiccant: Molecular sieve or silica gel, or blend of both.
- C. Glass: Comply with applicable requirements in "Glass Products" Article as indicated by designations in "Insulating-Glass Types" Article.

## 2.5 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.

## 2.6 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
- G. 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.

## 2.7 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
- C. Grind smooth and polish exposed glass edges and corners.

## 2.8 MONOLITHIC-GLASS TYPES

- A. Glass Type G6: As indicated on glass schedule.
- B. Glass Type G7: As indicated on glass schedule.
- C. Glass Type G8: As indicated on glass schedule.
- D. Glass Type G10: As indicated on glass schedule.

## 2.9 INSULATING-LAMINATED-GLASS TYPES

- A. Glass Type G1: As indicated on glass schedule.
- B. Glass Type G2: As indicated on glass schedule.
- C. Glass Type G3: As indicated on glass schedule.
- D. Glass Type G4: As indicated on glass schedule.
- E. Glass Type G5: As indicated on glass schedule.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
  - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.

2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

### 3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. 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.
  1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
  2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- 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.
- I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.



- J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- K. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- L. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

#### 3.4 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. 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.
- C. 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.
- D. Install gaskets so they protrude past face of glazing stops.

#### 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.
- E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 088000

## SECTION 089000 - LOUVERS AND VENTS

### 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. Fixed, extruded-aluminum louvers.

- B. Related Sections:

- 1. Division 04 Section "Unit Masonry Assemblies" for building wall vents .
  - 2. Division 07 Sections "Water Drainage Exterior Insulation and finish system" for louvers.
  - 3. Division 23 Sections for louvers that are a part of mechanical equipment.

#### 1.3 DEFINITIONS

- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
- B. Horizontal Louver: Louver with horizontal blades; i.e., the axes of the blades are horizontal.
- C. Storm-Resistant Louver: Louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural performance requirements and design criteria indicated.
- B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver 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.

- 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. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

#### 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
- B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
  - 1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Samples for Verification: For each type of metal finish required.
- E. Delegated-Design Submittal: For louvers indicated to comply with structural performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

#### 1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain louvers and vents from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.
- B. Welding: Qualify procedures and personnel according to the following:
  - 1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
- C. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

## 1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5, T-52, or T6.
- B. Fasteners: Use types and sizes to suit unit installation conditions.
  - 1. Use Phillips flat-head tamper-resistant screws for exposed fasteners unless otherwise indicated.
  - 2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
  - 3. For color-finished louvers, use fasteners with heads that match color of louvers.
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

### 2.2 FABRICATION, GENERAL

- A. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.
- B. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
  - 1. Frame Type: Channel unless otherwise indicated.
- C. Include supports, anchorages, and accessories required for complete assembly.
- D. Provide subsills made of same material as louvers for recessed louvers.
- E. Join frame members to each other and to fixed louver blades with fillet welds, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

### 2.3 FIXED, EXTRUDED-ALUMINUM LOUVERS

- A. Horizontal Storm-Resistant Louver

Basis-of-Design Product: Subject to compliance with requirements, provide Construction Specialties, Inc.; storm resistant louver model RS-4300 or comparable product by one of the following:

- a. Air Flow Company, Inc.
- b. Ruskin Company.

- c. Greenheck Fan Corporation.
  - d. Industrial Louvers, Inc.
  - e. Nystrom Building Products.
2. Louver Depth: 5 inches minimum or as required to meet performance criteria.
  3. Frame and Blade Nominal Thickness: Not less than 0.060 inch for blades and 0.080 inch for frames.
  4. Louver Performance Ratings:
    - a. Free Area: Not less than 45% free area and with Sizes as indicated on drawings.
    - b. Air Performance: Not more than 0.05-inch wg static pressure drop at 600-fpm free-area exhaust velocity.
    - c. Wind-Driven Rain Performance: Not less than 95 percent effectiveness when subjected to maximum water penetration rate of .05 oz water/ft<sup>2</sup> at a core-area intake velocity of 700 fpm.

## 2.4 LOUVER SCREENS

- A. General: Provide screen at each exterior louver.
  1. Screen Location for Fixed Louvers: Interior face.
  2. Screening Type: Bird screening.
- B. Secure screen frames to louver frames with machine screws with heads finished to match louver, spaced a maximum of 6 inches from each corner and at 12 inches o.c.
- C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.
  1. Metal: Same kind and form of metal as indicated for louver to which screens are attached.
  2. Finish: Mill finish unless otherwise indicated.
  3. Type: Non-rewirable, U-shaped frames.
- D. Louver Screening for Aluminum Louvers:
  1. Bird Screening: Stainless steel, 1/2-inch- square mesh, 0.047-inch wire.

## 2.5 BLANK-OFF PANELS

- A. Uninsulated, Blank-Off Panels: Metal sheet attached to back of louver.
  1. Aluminum sheet for aluminum louvers, not less than 0.050-inch nominal thickness.
  2. Panel Finish: Same type of finish applied to louvers, but black color.
  3. Attach blank-off panels with sheet metal screws.

## 2.6 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

## 2.7 ALUMINUM FINISHES

- A. Finish louvers after assembly.
- B. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and openings, with Installer present, 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 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

### 3.3 INSTALLATION

- A. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. 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.
- F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Division 7 Section "Joint Sealants" for sealants applied during louver installation.

### 3.4 ADJUSTING AND CLEANING

- A. Clean exposed surfaces of louvers and vents that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

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- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- C. Restore louvers and vents damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
  - 1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 089000

## SECTION 092216 - NON-STRUCTURAL METAL FRAMING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes non-load-bearing steel framing members for the following applications:
  - 1. Interior framing systems (e.g., supports for partition walls, framed soffits, furring, etc.).
  - 2. Interior suspension systems (e.g., supports for ceilings, suspended soffits, etc.).

#### 1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.

#### 1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in a assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

### PART 2 - PRODUCTS

#### 2.1 NON-LOAD-BEARING STEEL FRAMING, GENERAL

- A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
  - 1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.
  - 2. Protective Coating: ASTM A 653/A 653M, G40, hot-dip galvanized, unless otherwise indicated.

#### 2.2 SUSPENSION SYSTEM COMPONENTS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- diameter wire, or double strand of 0.0475-inch- diameter wire.
- B. Hanger Attachments to Concrete:



1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.
    - a. Type: Postinstalled, expansion anchor.
  2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.
- C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch diameter.
- D. Flat Hangers: Steel sheet, in size indicated on Drawings.
- E. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch and minimum 1/2-inch- wide flanges.
1. Depth: As indicated on Drawings.
- F. Furring Channels (Furring Members):
1. Cold-Rolled Channels: 0.0538-inch bare-steel thickness, with minimum 1/2-inch- wide flanges, 3/4 inch deep.
  2. Steel Studs: ASTM C 645.
    - a. Minimum Base-Metal Thickness: 0.0312 inch.
    - b. Depth: As indicated on Drawings.
  3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.
    - a. Minimum Base Metal Thickness: 0.0179 inch.
  4. Resilient Furring Channels: 1/2-inch- deep members designed to reduce sound transmission.
    - a. Configuration: Asymmetrical or hat shaped.
- G. Grid Suspension System for Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Armstrong World Industries, Inc.; Drywall Grid Systems.
    - b. Chicago Metallic Corporation Drywall Furring System.
    - c. USG Corporation; Drywall Suspension System.

## 2.3 STEEL FRAMING FOR FRAMED ASSEMBLIES

- A. Steel Studs and Runners: ASTM C 645.
1. Minimum Base-Metal Thickness: 0.0312 inch.
  2. Depth: As indicated on Drawings.
- B. Slip-Type Head Joints: Where indicated, provide one of the following:
1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
  2. Double-Runner System: A STM C 645 top runners, inside runner with 2-inch- deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
  3. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) Steel Network Inc. (The); VertiClip SLD Series.
      - 2) Superior Metal Trim; Superior Flex Track System (SFT).
- C. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Fire Trak Corp.; Fire Trak attached to studs with Fire Trak Slip Clip.
    - b. Metal-Lite, Inc.; The System.
- D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
1. Minimum Base-Metal Thickness: 0.0312 inch.
- E. Cold-Rolled Channel Bridging: 0.0538-inch bare-steel thickness, with minimum 1/2-inch- wide flanges.
1. Depth: 1-1/2 inches.
  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: 0.0179 inch.
  2. Depth: 7/8 inch.
- G. Resilient Furring Channels: 1/2-inch- deep, steel sheet members designed to reduce sound transmission.

1. Configuration: Asymmetrical or hat shaped.
- H. Cold-Rolled Furring Channels: 0.0538-inch bare-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 bare-steel thickness of 0.0312 inch.
  3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch-diameter wire, or double strand of 0.0475-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 bare-metal thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.

## 2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
1. 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 one of the following:
1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I ( No. 15 asphalt felt), nonperforated.
  2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Coordination with Sprayed Fire-Resistive Materials:
1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches o.c.

2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

### 3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754, except comply with framing sizes and spacing indicated.
  1. 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.

### 3.4 INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components in sizes and spacings indicated on Drawings, but not less than those required by referenced installation standards for assembly types and other assembly components indicated.
- 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 required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
    - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
  3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
  4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for

structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.

5. Do not attach hangers to steel roof deck.
  6. Do not attach hangers to permanent metal forms.
  7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
  8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.
- F. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- G. 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.

### 3.5 INSTALLING FRAMED ASSEMBLIES

- A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- B. Install studs so flanges within framing system point in same direction.
- C. 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. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
    - c. 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. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

- a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
- D. 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.
- E. Z-Furring Members:
1. Erect insulation (specified in Division 07 Section "Thermal 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.
- F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

END OF SECTION 092216

SECTION 09 2400 - PORTLAND CEMENT PLASTERING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Portland cement plaster on metal lath.
  - 2. Trim.
- B. Related Sections:
  - 1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

- A. ASTM International (ASTM):
  - 1. C150 - Standard Specification for Portland Cement.
  - 2. C206 - Standard Specification for Finishing Hydrated Lime.
  - 3. C847 - Standard Specification for Metal Lath.
  - 4. C897 - Standard Specification for Aggregates for Job-Mixed Portland Cement-Based Plasters.
  - 5. C926 - Standard Practice for Application of Portland Cement-Based Plaster.
  - 6. C932 - Standard Specification for Surface-Applied Bonding Compounds for Exterior Plastering.
  - 7. C1063 - Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster.
- B. National Association of Architectural Metal Manufacturers (NAAMM) ML/SFA 920 - Guide Specifications for Metal Lathing and Furring.

1.3 SUBMITTALS

- A. Submittals for Review:
  - 1. Samples:
    - a. 3 x 3 inch plaster samples showing available colors.
    - b. After color selection, submit] 12 x 12 inch plaster samples showing finish coat in selected color and texture.
    - c. 6 inch long trim samples.
  - 2. Hot weather procedures: Description of proposed application and curing procedures.

1.4 QUALITY ASSURANCE

- A. Applicator Qualifications: Minimum 5 years documented experience in work of this Section.
- B. Mockup:
  - 1. Size: 50 square feet.
  - 2. Show: Plaster color and texture, horizontal and vertical control joints, and casings.
  - 3. Locate where directed.

1.5 PROJECT CONDITIONS

- A. Cold Weather Requirements: Do not apply plaster unless minimum ambient temperature is above 50 degrees F for 48 hours prior to, during, and after application and during curing period.
- B. Hot Weather Requirements:

1. At ambient temperature above 85degrees F, relative humidity less than 75 percent, or winds in excess of 20 MPH, fog surface with water and cover with minimum 6 mil polyethylene film weighted or taped in place.
2. Leave coverings in place minimum 48 hours after application.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers - Metal Furring:
  1. Dietrich Metal Framing, Inc.
  2. Marino Ware Industries.
  3. Unimast, Inc.
- B. Acceptable Manufacturers - Metal Lath:
  1. Alabama Metal Industries Corp.
  2. CEMCO / California Expanded Products Co.
  3. Marino Ware Industries.
- C. Acceptable Manufacturers - Plaster Materials:
  1. LaHabra Stucco.
  2. Merlex Stucco, Inc.
  3. Sto Corporation
  4. UltraKote Products, Inc.
  5. Whitestone White Cement Co.
  - 6.
- D. Substitutions: Under provisions of Division 01.

### 2.2 MATERIALS

- A. Metal Lath:
  1. ASTM C847, expanded self-furring diamond mesh, galvanized.
- B. Plaster Materials:
  1. Portland cement: ASTM C150, Type 1.
  2. Lime: ASTM C206, Type S.
  3. Sand: ASTM C897, natural or manufactured, uniformly graded.
  4. Plaster mix reinforcement: ASTM C116, glass fibers, produced specifically for integral plaster reinforcement, chopped to ½ inch nominal length, alkali resistant.
  5. Finish coat: Elastomeric acrylic finish by Sto or approved substitute; color to be selected from manufacturer's standards.
  6. Water: Potable.

### 2.3 ACCESSORIES

- A. Trim Accessories:
  1. Corner bead: Beaded edge, size and profile to suit application.
  2. Casing bead: Thickness governed by plaster thickness, square edge.
  3. Control joint: Accordion profile with minimum 2 inch flanges each side.
- B. Fasteners: Type and size suited to application, hot-dip galvanized or fluoropolymer coated steel.
- C. Tie Wire: 16 gage, galvanized steel, soft annealed.



## 2.4 MIXES

- A. Proportions:
  - 1. Scratch and brown coats: ASTM C926, Type CL. Add glass fibers at a rate of 1-1/2 pounds per sack of cement.
  - 2. Finish Coat: Mix in accordance with manufacturer's instructions.
- B. Mixing:
  - 1. Use mechanical mixer.
  - 2. Mix each batch separately; double batching with single batch discharge not acceptable.
  - 3. Accurately proportion materials for initial mixture using measuring devices of known volume. Sand may be added by shovel after mixer is calibrated with known volumes of materials, including water.
  - 4. Thoroughly mix materials dry before adding water. Continue mixing for 3 to 5 minutes after all ingredients have been added.
  - 5. Clean equipment after each batch.
  - 6. Mixtures may be retempered one time after initial mixing.
  - 7. Discard frozen, caked, and hardened mixes. Discard mixes not used within 1-1/2 hours after initial mixing.

## PART 3 EXECUTION

### 3.1 INSTALLATION OF METAL LATH

- A. Perform Work in accordance with ASTM C1063.
- B. Apply with long dimension perpendicular to supports, with end joints staggered and occurring over supports.
- C. Lap ends minimum 1 inch and sides minimum 1-1/2 inches.
- D. Screw to framing at maximum 6 inches on center.
- E. Stop lath at each side of expansion and control joints and secure.
- F. Reinforce corners of openings with 6 x 12 inch lath strip installed diagonally at each corner, wire tied to lath.
- G. If lath is not continued minimum 3 inches on each side of internal corners, reinforce with 12 inch wide lath strip bent at 90 degrees and wire tied to lath.

### 3.2 INSTALLATION OF ACCESSORIES

- A. Install casing beads where plaster abuts dissimilar material or stops with edge exposed.
- B. Install corner beads at external corners.
- C. Install control joints:
  - 1. Locate as follows unless otherwise indicated:
    - a. As required to limit each area of plaster to 144 square feet with no dimension exceeding 12 feet.
    - b. Vertically above and below each side of openings.
    - c. Horizontally at each floor line.
  - 2. Run vertical joints continuous; butt horizontal joints into vertical joints.
  - 3. Apply joint sealer to form waterstop behind joints at intersections.

- D. Set level and true to line.

### 3.3 APPLICATION OF PLASTER

- A. Apply plaster in accordance with ASTM C926.
- B. Apply scratch, brown, and finish coats to minimum 5/8 inch thickness from face of lath.
- C. Dampen each coat prior to applying succeeding coats.
- D. Scratch Coat:
  - 1. [Form full keys on lath.] Cross rake surface to bond brown coat.
- E. Brown Coat:
  - 1. Bring out to grounds and rod level.
  - 2. Float surface to provide surface texture receptive to application of finish coat.
- F. Finish Coat:
  - 1. Apply to nominal 1/8 inch thickness.
  - 2. Work from wet edges to apply unbroken area in one continuous operation to eliminate joints.
  - 3. Finish surfaces to smooth float and heavy float texture. Refer to drawings for locations of each texture.
  - 4. Finish surfaces true to plane, plumb and with neat, sharp corners and intersections.
  - 5. Work in panels to nearest natural break formed by intersections, corners, trim, and accessories.
  - 6. Tool plaster to V-joint at trim, grounds and accessories.
  - 7. Not acceptable: Lines caused by variations in application or finishing techniques, cold joints, and other surface defects visible when viewed from a distance of 10 feet.
- G. After application of each coat, fog spray plaster with clean water in sufficiently frequent applications to maintain plaster uniformly moist for minimum of 48 hours.
- H. Installation Tolerances:
  - 1. Plaster: Maximum 1/8 inch in 10 feet variation from true flatness.
  - 2. Trim: Maximum 1/4 inch in 10 feet variation from plumb, level, or true plane, noncumulative.

### 3.4 ADJUSTING

- A. Repair or replace damaged, discolored, and defective plaster. Match patched areas to surrounding plaster.

### 3.5 CLEANING

- A. Clean plaster from trim and accessories before it sets.

END OF SECTION 09 2400

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Interior gypsum board.
2. Tile backing panels.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
- C. Source Limitations: Obtain gypsum board and gypsum board shaft wall from single source from single manufacturer.

1.4 STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install interior products until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

## PART 2 - PRODUCTS

### 2.1 PANELS, GENERAL

- A. Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

### 2.2 INTERIOR GYPSUM BOARD

- A. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Gypsum Co.
    - b. BPB America Inc.
    - c. G-P Gypsum.
    - d. Lafarge North America Inc.
    - e. National Gypsum Company.
    - f. USG Corporation.
- B. Regular Type:
  1. Thickness: 1/2 inch.
  2. Long Edges: Tapered.
- C. Type X:
  1. Thickness: 5/8 inch.
  2. Long Edges: Tapered.
- D. Ceiling Type: Manufactured to have more sag resistance than regular-type gypsum board.
  1. Thickness: 1/2 inch.
  2. Long Edges: Tapered.

### 2.3 TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Board:
  1. Complying with ASTM C1177/C 1177M.

- a. Product: Subject to compliance with requirements, provide " DensArmor Plus Interior Guard" by G-P Gypsum.
2. Core: As indicated on Drawings.

## 2.4 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.
2. Shapes:
  - a. Cornerbead.
  - b. Bullnose bead.
  - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
  - d. L-Bead: L-shaped; exposed long flange receives joint compound.
  - e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
  - f. Expansion (control) joint.
  - g. Curved-Edge Cornerbead: With notched or flexible flanges.

### B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Fry Reglet Corp.
  - b. Gordon, Inc.
  - c. Pittcon Industries.
2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221, Alloy 6063-T5.
3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

## 2.5 JOINT TREATMENT MATERIALS

### A. General: Comply with ASTM C 475/C 475M.

### B. Joint Tape:

1. Interior Gypsum Wallboard: Paper.
2. Tile Backing Panels: As recommended by panel manufacturer.

### C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.

- a. Use setting-type compound for installing paper-faced metal trim accessories.
  3. Fill Coat: For second coat, use drying-type, all-purpose compound.
  4. Finish Coat: For third coat, use drying-type, all-purpose compound.
  5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.
- D. Joint Compound for Tile Backing Panels:
1. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.

## 2.6 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
- D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- E. Acoustical Sealant: As specified in Division 07 Section "Joint Sealants."
- F. Thermal Insulation: As specified in Division 07 Section "Thermal Insulation."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
  - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
  - 2. Fit gypsum panels around ducts, pipes, and conduits.
  - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.
- G. 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.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- J. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.

### 3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
  - 1. Regular Type: Vertical surfaces, unless otherwise indicated.

2. Type X: As indicated on Drawings.
3. Ceiling Type: Ceiling surfaces.
4. Moisture- and Mold-Resistant Type: As indicated on Drawings.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.
2. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
  - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
  - b. At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.
3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying face layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints 1 framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

### 3.4 APPLYING TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Panel: Comply with manufacturer's written installation instructions and install at showers, tubs, and where indicated. Install with 1/4-inch gap where panels abut other construction or penetrations.
- B. Areas Not Subject to Wetting: Install regular-type gypsum wallboard panels to produce a flat surface except at showers, tubs, and other locations indicated to receive water-resistant panels.



- C. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

### 3.5 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints at locations indicated on Drawings.
- C. Interior Trim: Install in the following locations:
  - 1. Cornerbead: Use at outside corners, unless otherwise indicated.
  - 2. Bullnose Bead: Use at outside corners.
  - 3. LC-Bead: Use at exposed panel edges.
  - 4. L-Bead: Use where indicated.
  - 5. U-Bead: Use at exposed panel edges.
  - 6. Curved-Edge Cornerbead: Use at curved openings.
- D. Aluminum Trim: Install in locations indicated on Drawings.

### 3.6 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- D. 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 other Division 09 Sections.
  - 5. Level 5: Where indicated on Drawings.
    - a. Primer and its application to surfaces are specified in other Division 09 Sections.
- E. Glass-Mat, Water-Resistant Backing Panels: Finish according to manufacturer's written instructions.

3.7 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SECTION 093000 - TILING

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. Ceramic tile.
- 2. Tile backing panels.
- 3. Metal edge strips.

- B. Related Sections:

- 1. Division 07 Section "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.

1.3 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in "American National Standard Specifications for Installation of Ceramic Tile."
- C. Module Size: Actual tile size plus joint width indicated.
- D. Face Size: Actual tile size, excluding spacer lugs.

1.4 PERFORMANCE REQUIREMENTS

- A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:
  - 1. Level Surfaces: Minimum >.7 dry; >.6 wet.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.6 QUALITY ASSURANCE

- A. Source Limitations for Tile: Obtain tile of each type and color or finish from one source or producer.
  - 1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- B. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.
- E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

1.9 EXTRA MATERIALS

- 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.
  - 2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard grade requirements unless otherwise indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCA installation methods specified in tile installation schedules, and other requirements specified.
- C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.
- D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.
  1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.
- E. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

## 2.2 TILE PRODUCTS

- A. Tile Type PS1, PS2, PS3, PSB 1 and PSB2: Factory-mounted glazed ceramic mosaic tile.
  1. Provide product indicated on Drawings.
  2. Composition: Porcelain.
  3. Module Size: As indicated on drawings.
  4. Thickness: 1/4 inch.
  5. Face: Plain with cushion edges.
  6. Finish: Bright, clear glaze.
  7. Tile Color and Pattern: As indicated on Drawings.
  8. Grout Color: As indicated on Drawings.
  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 Cove: Cove, module size 18 by 3 inch, or 6 by 12 inch, see finish schedule.
    - b. External Corners for Thin-Set Mortar Installations: Surface bullnose, module size 18 by 3 inch, or 6 by 12 inch, see finish schedule.
    - c. Internal Corners: Field-buttet square corners. For coved base and cap, use angle pieces designed to fit with stretcher shapes.

## 2.3 SETTING MATERIALS

- A. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4.
  1. Provide prepackaged, dry-mortar mix combined with liquid-latex additive at Project site.

## 2.4 GROUT MATERIALS

- A. Grout for Pregrouted Tile Sheets: Same product used in factory to pre-grout tile sheets.

## 2.5 ELASTOMERIC SEALANTS

- A. General: Provide sealants, primers, backer rods, and other sealant accessories that comply with the following requirements and with the applicable requirements in Division 07 Section "Joint Sealants."
  - 1. Use primers, backer rods, and sealant accessories recommended by sealant manufacturer.
- B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints unless otherwise indicated.
- C. One-Part, Mildew-Resistant Silicone Sealant: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and extreme temperatures.

## 2.6 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; exposed-edge material.
- C. Temporary Protective Coating: Product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.
  - 1. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as temporary protective coating for tile.
- D. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
- E. Grout Sealer: Manufacturer's standard silicone product for sealing grout joints and that does not change color or appearance of grout.

## 2.7 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
  - 1. Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
  - 2. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thin-set mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. 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.
- C. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

## 3.3 TILE INSTALLATION

- A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA 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 TCA 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 composed of tiles 8 by 8 inches or larger.
- 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 piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

- D. Jointing Pattern: Lay tile in grid pattern shown on AF601 unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
  - 1. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
  - 2. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
  - 3. No cut tiles used in field.
- E. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
  - 1. Paver Tile: 1/4 inch.
- F. Metal Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.
- G. Grout Sealer: Apply grout sealer to cementitious grout joints in tile floors according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

### 3.4 CLEANING AND PROTECTING

- A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
  - 1. Remove latex-portland cement grout residue from tile as soon as possible.
  - 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
  - 3. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.
- B. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- D. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

END OF SECTION 093000



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. This Section includes acoustical panels and exposed suspension systems for ceilings.
- B. Related Sections include the following:
  - 1. Division 09 Section "Acoustical Tile Ceilings" for ceilings consisting of mineral-base acoustical tiles used with concealed suspension systems, stapling, or adhesive bonding.

1.3 DEFINITIONS

- A. AC: Articulation Class.
- B. CAC: Ceiling Attenuation Class.
- C. LR: Light Reflectance coefficient.
- D. NRC: Noise Reduction Coefficient.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.5 QUALITY ASSURANCE

- A. Source Limitations:
  - 1. Acoustical Ceiling Panel: Obtain each type through one source from a single manufacturer.
  - 2. Suspension System: Obtain each type through one source from a single manufacturer.
- B. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system through one source from a single manufacturer.
- C. Seismic Standard: Provide acoustical panel ceilings designed and installed to withstand the effects of earthquake motions according to the following:
  - 1. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E 580.

2. CISCA's Recommendations for Acoustical Ceilings: Comply with CISCA's "Recommendations for Direct-Hung Acoustical Tile and Lay-in Panel Ceilings--Seismic Zones 0-2."
3. CISCA's Guidelines for Systems Requiring Seismic Restraint: Comply with CISCA's "Guidelines for Seismic Restraint of Direct-Hung Suspended Ceiling Assemblies--Seismic Zones 3 & 4."
4. UBC Standard 25-2, "Metal Suspension Systems for Acoustical Tile and for Lay-in Panel Ceilings."
5. ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."

- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

#### 1.6 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.

#### 1.7 PROJECT 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.

#### 1.8 COORDINATION

- A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

#### 1.9 EXTRA MATERIALS

- 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. Acoustical Ceiling Panels: Full-size panels equal to 2.0 percent of quantity installed.
  2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of quantity installed.

### PART 2 - PRODUCTS

2.1 ACOUSTICAL PANELS, GENERAL

- A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.
  - 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface per ASTM E 795.
- B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
  - 1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.
- C. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

2.2 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING ACT 1

- A. Provide the product indicated on drawings.
- B. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:
  - 1. Type and Form: Type III, Form 2.
  - 2. Pattern: CE (perforated, small holes and lightly textured).
- C. Color: White.
- D. LR: Not less than 0.85.
- E. NRC: Not less than 0.50.
- F. CAC: Not less than 35.
- G. Edge/Joint Detail: Finline Bevel.
- H. Thickness: 5/8 inch.
- I. Modular Size: 24 by 24 inches.
- J. Antimicrobial Treatment: Broad spectrum fungicide and bactericide based.

2.3 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.

- B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.
  - 1. High-Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.
- C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
  - 1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing per ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
    - a. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.
    - b. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316 for bolts; Alloy 304 or 316 for anchor.
    - c. Corrosion Protection: Components fabricated from nickel-copper-alloy rods complying with ASTM B 164 for UNS No. N04400 alloy.
- D. 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.
  - 3. Nickel-Copper-Alloy Wire: ASTM B 164, nickel-copper-alloy UNS No. N04400.
  - 4. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch-diameter wire.
- E. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in place.

## 2.4 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING

- A. Provide the following:
  - 1. USG
- B. Narrow-Face, Single-Web, Extruded-Aluminum Suspension System: Main and cross runners formed from extruded aluminum to produce structural members with 9/16-inch-wide faces.
  - 1. Structural Classification: Intermediate-duty system.
  - 2. Face Design: Screw-slot profile.
  - 3. Face Finish: Painted white.
  - 4. Reveal Finish: Painted white.

## 2.5 ACOUSTICAL SEALANT

- A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex 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.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or a but, 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.
  - 1. 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 and seismic design requirements indicated, per 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, countersplaying, 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. 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.
  - 6. When steel framing does not permit in stallation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
  - 7. Do not attach hangers to steel deck tabs.
  - 8. Do not attach hangers to steel roof deck. Attach hangers to structural members.
  - 9. 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.
  - 10. 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 suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- E. 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. Arrange directionally patterned acoustical panels as follows:
    - a. As indicated on reflected ceiling plans.
    - b. Install panels in a basket-weave pattern.
  - 2. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
  - 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.

#### 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 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. Resilient base.
- B. Related Sections:
  - 1. Division 09 Section "Resilient Tile Flooring" for resilient floor tile.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 65 deg F or more than 90 deg F.

1.5 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following time periods:
  - 1. 48 hours before installation.
  - 2. During installation.
  - 3. 48 hours after installation.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

1.6 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

## PART 2 - PRODUCTS

### 2.1 RESILIENT BASE RB1

#### A. Resilient Base:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. Johnsonite.

#### B. Resilient Base Standard: ASTM F 1861.

1. Material Requirement: Type T S ( rubber, vulcanized thermoset) or Type T P (rubber, thermoplastic).
2. Manufacturing Method: Group I (solid, homogeneous).
3. Style: Cove (base with toe)

#### C. Minimum Thickness: 0.125 inch.

#### D. Height: As indicated on Drawings.

#### E. Lengths: Coils in manufacturer's standard length.

#### F. Outside Corners: Job formed. See Manufacturer's written instructions for field-made corners.

#### G. Inside Corners: Job formed. See Manufacturer's written instructions for field-made corners.

#### H. Colors and Patterns: As indicated on Drawings.

### 2.2 RESILIENT MOLDING ACCESSORY VTS1 and VTS2

#### A. Resilient Molding Accessory:

1. Manufacturers: Subject to compliance with requirements, provide products of the following:
  - a. Johnsonite.

#### B. Description: Reducer strip for resilient floor covering; Joiner for tile and carpet; Transition strips..

#### C. Material: Vinyl.

#### D. Profile and Dimensions: As indicated on Drawings..

#### E. Colors and Patterns: As indicated on Drawings.

### 2.3 INSTALLATION MATERIALS



- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. 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.
- C. 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.
- D. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

#### 3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as 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.

- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Job-Formed Corners:
  - 1. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends.
  - 2. Inside Corners: Use straight pieces of maximum lengths possible.

### 3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of carpet and resilient floor covering that would otherwise be exposed.

### 3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.
- B. Perform the following operations immediately after completing resilient product installation:
  - 1. Remove adhesive and other blemishes from exposed surfaces.
  - 2. Sweep and vacuum surfaces thoroughly.
  - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect resilient products from marks, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products until Substantial Completion.

END OF SECTION 096513

SECTION 096519 - RESILIENT TILE FLOORING

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. Solid vinyl floor tile.

- B. Related Sections:

- 1. Division 09 Section "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with resilient floor coverings.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

- A. Fire-Test-Response C 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.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

1.6 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 60 deg for more than 81 deg F, in spaces to receive floor tile during the following time periods:

- 1. 48 hours before installation.
  - 2. During installation.
  - 3. 48 hours after installation.

- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Close spaces to traffic during floor tile installation.
- D. Close spaces to traffic for 48 hours after floor tile installation.
- E. Install floor tile after other finishing operations, including painting, have been completed.

#### 1.7 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Floor Tile: Furnish 1 box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

### PART 2 - PRODUCTS

#### 2.1 SOLID VINYL FLOOR TILE VT1

- A. Products: As indicated on Drawings (subject to compliance with requirements).
- B. Tile Standard: ASTM F 1700.
  - 1. Class: Class III, printed film vinyl tile.
  - 2. Type: Type B, embossed surface.
- C. Thickness: 0.100 inch.
- D. Size: 12 by 12 inches. Seaming Method: Standard.
- E. Colors and Patterns: As indicated on Drawings.

#### 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 floor tile and substrate conditions indicated.
- C. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: 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. Proceed with installation only after substrates pass testing.
  - 4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.
    - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
    - b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 7.5% relative humidity level measurement.
- 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 floor tiles until they are same temperature as space where they are to be installed.
  - 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

### 3.3 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
  - 1. Lay tiles square with room axis.

- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
  - 1. Lay tiles with grain running in one direction.
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.
- G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- H. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

### 3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of floor tile.
- B. Perform the following operations immediately after completing floor tile installation:
  - 1. Remove adhesive and other blemishes from exposed surfaces.
  - 2. Sweep and vacuum surfaces thoroughly.
  - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect floor tile products from marks, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor tile surfaces before applying liquid floor polish.
  - 1. Apply two coat(s).
- E. Cover floor tile until Substantial Completion.

END OF SECTION 096519

SECTION 096813 - TILE CARPETING

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 modular, tufted textured loop pile carpet tile.
- B. Related Sections include the following:
  - 1. Division 09 Section "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.

1.3 QUALITY ASSURANCE

- A. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to carpet tile installation including, but not limited to, the following:
  - 1. Review delivery, storage, and handling procedures.
  - 2. Review ambient conditions and ventilation procedures.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104, Section 5, "Storage and Handling."

1.5 PROJECT CONDITIONS

- A. Comply with CRI 104, Section 7.2, "Site Conditions; Temperature and Humidity" and Section 7.12, "Ventilation."
- B. Environmental Limitations: Do not install carpet tiles until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

PART 2 - PRODUCTS

2.1 CARPET TILE CPT 1

- A. Carpet and adhesive materials shall be owner furnished and Contractor installed. Carpet and adhesive materials will be delivered to the jobsite at the appropriate stage of the work. Contractor shall furnish labor and coordinate installation as well as warranty the carpet installation as part of their work.

2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
  - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
  - 2. Subfloor finishes comply with requirements specified in Division 03 Section "Cast-in-Place Concrete" for slabs receiving carpet tile.
  - 3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: 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.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider and protrusions more than 1/32 inch, unless more stringent requirements are required by manufacturer's written instructions.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION



NFCU

- A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: Monolithic.
- C. Maintain dye lot integrity. Do not mix dye lots in same area.
- D. 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.
- E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- F. 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.
- G. Install pattern parallel to walls and borders.

#### 3.4 CLEANING AND PROTECTION

- A. 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.
- B. Protect installed carpet tile to comply with CRI 104, Section 16, "Protection of Indoor Installations."
- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813

SECTION 097200 - WALL COVERINGS

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. Vinyl wall covering.
- B. Related Sections:
  - 1. Division 09 Section "Interior Painting" for priming wall surfaces.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Schedule: For wall coverings WC1, WC2, WC3, and WC4.
- C. Maintenance Data: For wall coverings to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing identical wall coverings applied with identical adhesives to substrates according to test method indicated below by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Surface-Burning Characteristics: As follows, per ASTM E 84:
    - a. Flame-Spread Index: 20 or less.
    - b. Smoke-Developed Index: 100 or less.
  - 2. Fire-Growth Contribution: Textile wall coverings tested according to NFPA 286 and complying with test protocol and criteria in the 2003 IBC.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install wall coverings until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

- B. Lighting: Do not install wall covering until a permanent level of lighting is provided on the surfaces to receive wall covering.
- C. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall-covering manufacturer for full drying or curing.

#### 1.6 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Wall-Covering Materials: For each type, full-size units equal to 10 percent of amount installed.

### PART 2 - PRODUCTS

#### 2.1 WALL COVERINGS

- A. General: Provide rolls of each type of wall covering from same print run or dye lot.
- B. Vinyl Wall-Covering Standards: Provide mildew-resistant products complying with the following:
  - 1. Products: As indicated on Drawings (subject to compliance with requirements). Perforate all vinyl wall coverings to be used at exterior walls.

#### 2.2 ACCESSORIES

- A. Adhesive: Mildew-resistant, nonstaining, strippable adhesive, for use with specific wall covering and substrate application; as recommended in writing by wall-covering manufacturer.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for levelness, wall plumbness, maximum moisture content, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances that could impair bond of wall covering, including dirt, oil, grease, mold, mildew, and incompatible primers.
- C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.

1. Moisture Content: Maximum of 5 percent on new plaster, concrete, and concrete masonry units when tested with an electronic moisture meter.
  2. Gypsum Board: Prime with primer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
- D. Check painted surfaces for pigment bleeding. Sand gloss, semigloss, and eggshell finish with fine sandpaper.
- E. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.
- F. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.
- G. Install wall liner, with no gaps or overlaps, where required by wall-covering manufacturer. Form smooth wrinkle-free surface for finished installation. Do not begin wall-covering installation until wall liner has dried.

### 3.3 INSTALLATION

- A. General: Comply with wall-covering manufacturers' written installation instructions applicable to products and applications indicated except where more stringent requirements apply.
- B. Cut wall-covering strips in roll number sequence. Change roll numbers at partition breaks and corners.
- C. Install strips in same order as cut from roll.
- D. Install wall covering with no gaps or overlaps, no lifted or curling edges, and no visible shrinkage.
- E. Match pattern 72 inches above the finish floor.
- F. Install seams vertical and plumb at least 6 inches from outside corners and 6 inches from inside corners unless a change of pattern or color exists at corner. No horizontal seams are permitted.
- G. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.
- H. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without any overlay or spacing between strips.

### 3.4 CLEANING

- A. Remove excess adhesive at finished seams, perimeter edges, and adjacent surfaces.
- B. Use cleaning methods recommended in writing by wall-covering manufacturer.
- C. Replace strips that cannot be cleaned.
- D. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

END OF SECTION 097200

SECTION 099113 - EXTERIOR PAINTING

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 surface preparation and the application of paint systems on the following exterior substrates:
  - 1. Exterior Insulation Finish System (EIFS).
  - 2. Steel.
  - 3. Galvanized metal.
  - 4. Exterior opaque wood stain.
- B. Related Sections include the following:
  - 1. Division 05 Sections for shop priming of metal substrates with primers specified in this Section.
  - 2. Division 09 Section "Interior Painting" for surface preparation and the application of paint systems on interior substrates.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: For each type of paint system and each color and gloss of topcoat indicated.
  - 1. Submit Samples on rigid backing, 8 inches square.
  - 2. Step coats on Samples to show each coat required for system.
- C. Product List: For each product indicated, include the following:
  - 1. Cross-reference to paint system and locations of application areas.
  - 2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.4 QUALITY ASSURANCE

- A. MPI Standards:
  - 1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
  - 2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

## NFCU

### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
  - 1. Maintain containers in clean condition, free of foreign materials and residue.
  - 2. Remove rags and waste from storage areas daily.

### 1.6 PROJECT CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

### 1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
  - 1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. of each material and color applied.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Benjamin Moore & Co.
  - 2. ChemRex.
  - 3. Del Technical Coatings.
  - 4. Kryton Canada Corporation.
  - 5. Vista Paint.

### 2.2 PAINT, GENERAL

- A. 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.
- B. Colors: As indicated on Drawings (subject to compliance with requirements).

### 2.3 METAL PRIMERS

## NFCU

- A. Alkyd Anticorrosive Metal Primer: MPI #79.
  - 1. VOC Content: E Range of E2.
- B. Cementitious Galvanized-Metal Primer: MPI #26.
  - 1. VOC Content: E Range of E1.
- C. Quick-Drying Primer for Aluminum: MPI #95.
  - 1. VOC Content: E Range of E2.

## 2.4 EXTERIOR ALKYD PAINTS

- A. Exterior Alkyd Enamel (Flat): MPI #8 (Gloss Level 1).
  - 1. VOC Content: E Range of E1.
- B. Exterior Alkyd Enamel (Semigloss): MPI #94 (Gloss Level 5).
  - 1. VOC Content: E Range of E1.
- C. Exterior Alkyd Enamel (Gloss): MPI #9 (Gloss Level 6).
  - 1. VOC Content: E Range of E1.
- D. Low Luster Acrylic Finish for exterior gypsum and primer.

## 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 work.
- B. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- C. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
  - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove plates, machined surfaces, and similar items already in place that 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.
  2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- D. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.
- E. Galvanized-Metal Substrates : Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

### 3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions.
1. Use applicators and techniques suited for paint and substrate indicated.
  2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show too rough to pcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. 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. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### 3.5 EXTERIOR PAINTING SCHEDULE



- A. Steel Substrates:
  - 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).
- B. Galvanized-Metal Substrates:
  - 1. Alkyd System: MPI EXT 5.3B.
    - a. Prime Coat: Cementitious galvanized-metal primer.
    - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
    - c. Topcoat: Exterior alkyd enamel (flat).
- C. Aluminum Substrates:
  - 1. Alkyd System: MPI EXT 5.4F.
    - a. Prime Coat: Quick-drying primer for aluminum.
    - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
    - c. Topcoat: Exterior alkyd enamel (flat).
- D. Exterior Insulation Finish System Substrates:
  - 1. Latex System: MPI EXT 9.2A.
    - a. Prime Coat: Exterior latex matching topcoat.
    - b. Intermediate Coat: Exterior latex matching topcoat.
    - c. Topcoat: Exterior latex flat.
- E. Exterior opaque wood stains.
  - 1. Oil based (alkyd) stain. Mildew resistant. Benjamin Moore. Color as indicated on drawings.
    - a. Intermediate Coat - Exterior alkyd
    - b. Topcoat – Match intermediate coat

END OF SECTION 099113

SECTION 099123 - INTERIOR PAINTING

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 surface preparation and the application of paint systems on the following interior substrates:
  - 1. Steel.
  - 2. Gypsum board.
- B. Related Sections include the following:
  - 1. Division 09 Section " Exterior Painting" for surface preparation and the application of paint systems on exterior substrates.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat indicated.
  - 1. Submit Samples on rigid backing, 8 inches square.
  - 2. Step coats on Samples to show each coat required for system.
  - 3. Label each coat of each Sample.
  - 4. Label each Sample for location and application area.
- C. Product List: For each product indicated, include the following:
  - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
  - 2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.4 QUALITY ASSURANCE

- A. MPI Standards:
  - 1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
  - 2. Preparation and Workmanship: Comply with requirements in " MPI Architectural Painting Specification Manual" for products and paint systems indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
  - 1. Maintain containers in clean condition, free of foreign materials and residue.
  - 2. Remove rags and waste from storage areas daily.

#### 1.6 PROJECT CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

#### 1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
  - 1. Quantity: Furnish an additional 10 percent, but not less than 1 gal. of each material and color applied.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Benjamin Moore & Co.
  - 2. ICI Paints

#### 2.2 PAINT, GENERAL

- A. 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.
- B. VOC Content of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24); these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:
  - 1. Flat Paints, Coatings, and Primers: VOC content of not more than 0 g/L.
  - 2. Nonflat Paints, Coatings, and Primers: VOC content of not more than 1 g/L.
  - 3. Shellacs, Clear: VOC not more than 730 g/L.
  - 4. Shellacs, Pigmented: VOC not more than 550 g/L.

5. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 48 g/L.
6. Primers, Sealers, and Undercoaters: VOC content of not more than 200 g/L.

C. Chemical Components of Field-Applied Interior Paints and Coatings: Provide topcoat paints and anti-corrosive and anti-rust paints applied to ferrous metals that comply with the following chemical restrictions; these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:

1. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
2. Restricted Components: Paints and coatings shall not contain any of the following:
  - a. Acrolein.
  - b. Acrylonitrile.
  - c. Antimony.
  - d. Benzene.
  - e. Butyl benzyl phthalate.
  - f. Cadmium.
  - g. Di (2-ethylhexyl) phthalate.
  - h. Di-n-butyl phthalate.
  - i. Di-n-octyl phthalate.
  - j. 1,2-dichlorobenzene.
  - k. Diethyl phthalate.
  - l. Dimethyl phthalate.
  - m. Ethylbenzene.
  - n. Formaldehyde.
  - o. Hexavalent chromium.
  - p. Isophorone.
  - q. Lead.
  - r. Mercury.
  - s. Methyl ethyl ketone.
  - t. Methyl isobutyl ketone.
  - u. Methylene chloride.
  - v. Naphthalene.
  - w. Toluene (methylbenzene).
  - x. 1,1,1-trichloroethane.
  - y. Vinyl chloride.

D. Colors: As indicated in a color schedule.

### 2.3 PRIMERS/SEALERS

A. Interior Latex Primer/Sealer: MPI #50.

1. VOC Content: E Range of E3.
2. Environmental Performance Rating: EPR 3.

### 2.4 METAL PRIMERS

A. Alkyd Anticorrosive Metal Primer: MPI #79.

1. VOC Content: E Range of E2

## NFCU

- B. Quick-Drying Alkyd Metal Primer: MPI #76.
  - 1. VOC Content: E Range of E3.
- C. Quick-Drying Primer for Aluminum: MPI #95.
  - 1. VOC Content: E Range of E3.

## 2.5 LATEX PAINTS

- A. Interior Latex (Flat): MPI #53 (Gloss Level 1). PT3
  - 1. VOC Content: E Range of E3.
  - 2. Environmental Performance Rating: EPR 2.5.
- B. Interior Latex (Eggshell): MPI #52 (Gloss Level 3). PT1 and PT2
  - 1. VOC Content: E Range of E3.
  - 2. Environmental Performance Rating: EPR 3.

## 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 work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  - 1. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
  - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Remove plates, machined surfaces, and similar items already in place that 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.
  - 2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

- C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- D. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.
- E. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.

### 3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions.
  - 1. Use applicators and techniques suited for paint and substrate indicated.
  - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
  - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. 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. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### 3.5 INTERIOR PAINTING SCHEDULE

- A. Steel Substrates:

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1. Alkyd Dry-Fall System: MPI INT 5.1D.

- a. Prime Coat: Latex metal primer.
- b. Topcoat: Flat Latex.

B. Gypsum Board Substrates:

1. Latex System: MPI INT 9.2A.

- a. Prime Coat: Interior latex primer/sealer.
- b. Intermediate Coat: Interior latex matching topcoat.
- c. Topcoat: Interior latex Flat at SWB Ceilings and underside of soffits, eggshell at vertical surfaces

END OF SECTION 099123

## SECTION 102800 - TOILET AND BATH 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. This Section includes the following:
  - 1. Public-use washroom accessories.
  - 2. Custodial accessories.
- B. Owner-Furnished Material.
- C. Related Sections include the following:
  - 1. Division 06 Section "Rough Carpentry."
  - 2. Division 09 Section "Tiling" for ceramic toilet and bath accessories.
  - 3. Division 22 Section "Plumbing Fixtures."

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include the following:
  - 1. Construction details and dimensions.
  - 2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
  - 3. Material and finish descriptions.
  - 4. Features that will be included for Project.
  - 5. Manufacturer's warranty.
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
  - 1. Identify locations using room designations indicated on Drawings.
  - 2. Identify products using designations indicated on Drawings.
- C. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

#### 1.4 QUALITY ASSURANCE

- A. Source Limitations: For products listed together in the same articles in Part 2, provide products of same manufacturer unless otherwise approved by Architect.



NFCU

### 1.5 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

### 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: 15 years from date of Substantial Completion.

## PART 2 - PRODUCTS

- A. All Toilet and Bath Accessories products are as indicated on drawings.

## 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 method in ASTM F 446.

### 3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 102800

SECTION 104413 - FIRE EXTINGUISHER CABINETS

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. Fire protection cabinets for the following:
    - a. Portable fire extinguishers.
- B. Related Sections:
  - 1. Division 10 Section "Fire Extinguishers."

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.
  - 1. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.

1.4 COORDINATION

- A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

1.5 SEQUENCING

- A. Apply decals on field-painted, fire protection cabinets after painting is complete.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Stainless-Steel Sheet: ASTM A 666, Type 304.

- B. Transparent Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), 3 mm thick, with Finish 1 (smooth or polished).

## 2.2 FIRE PROTECTION CABINET SPEC

- A. Cabinet Type: Suitable for fire extinguisher.
  - 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. Larsen's Manufacturing Company;.
- B. Cabinet Construction: Nonrated Semi-recessed.
- C. Cabinet Material: Stainless-steel sheet.
- D. Cabinet Trim Material: Stainless-steel sheet.
- E. Door Material: Stainless-steel sheet.
- F. Door Style: Fully glazed, frameless, backless, acrylic panel.
- G. Door Glazing: Acrylic sheet.
  - 1. Acrylic Sheet Color: Clear transparent acrylic sheet.
- H. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
  - 1. Provide projecting door pull and friction latch] [ recessed door pull and friction latch] [manufacturer's standard.
  - 2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.
- I. Finishes:
  - 1. Stainless Steel: No. 4.

## 2.3 FABRICATION

- A. Fire Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
  - 1. Weld joints and grind smooth.
  - 2. Provide factory-drilled mounting holes.
  - 3. Prepare doors and frames to receive locks.
  - 4. Install door locks at factory.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
  - 1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.

2. Miter and weld perimeter door frames.

#### 2.4 GENERAL FINISH REQUIREMENTS

- A. Comply with N AAMM's " Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces of fire protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire protection cabinets after assembly.
- D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

#### 2.5 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
  1. Run grain of directional finishes with long dimension of each piece.
  2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
  3. Directional Satin Finish: No. 4.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. General: Install fire protection cabinets in locations and at mounting heights indicated below:
  1. Fire Protection Cabinets: 54 inches above finished floor to top of cabinet.
- B. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.
  1. Unless otherwise indicated, provide recessed fire protection cabinets. If wall thickness is not adequate for recessed cabinets, provide semirecessed fire protection cabinets.
  2. Fasten mounting brackets to inside surface of fire protection cabinets, square and plumb.
- C. Identification: Apply decals at locations indicated.

#### 3.3 ADJUSTING AND CLEANING

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- A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.
- E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104413

SECTION 104416 - FIRE EXTINGUISHERS

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 portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.
- B. Related Sections:
  - 1. Division 10 Section "Fire Extinguisher Cabinets."
  - 2. Division 21 Section "Water-Based Fire-Suppression Systems" for hose systems, racks, and valves.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting bracket.
- B. Product Schedule: For fire extinguishers. Coordinate final fire extinguisher schedule with fire protection cabinet schedule to ensure proper fit and function.
- C. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.
- D. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

- 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.
  - 1. Provide fire extinguishers approved, listed, and labeled by FMG.

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. Failures include, but are not limited to, the following:
    - a. Failure of hydrostatic test according to NFPA 10.
    - b. Faulty operation of valves or release levers.
  - 2. Warranty Period: Six years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire protection cabinet and 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. Badger Fire Protection; a Kidde company.
    - b. Buckeye Fire Equipment Company.
    - c. J. L. Industries, Inc.; a division of Activar Construction Products Group.
    - d. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
    - e. Larsen's Manufacturing Company.
    - f. Potter Roemer LLC.
  - 2. Handles and Levers: Manufacturer's standard.
  - 3. 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. Halon Type FEX: UL-rated 5-B:C, 2.5-lb nominal capacity, in enameled-steel container; with pressure-indicating gage.

### 2.2 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 black baked-enamel finish.

Manufacturers: Product indicated on Drawings.

- a. Larsen's Manufacturing Company.
- 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 EXAMINATION

- A. Examine fire extinguishers for proper charging and tagging.
  - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: 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.
- B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 104416



SECTION 107500 - FLAGPOLES

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 ground-mounted flagpoles made from aluminum.
- B. Contractor-Furnished Material: Flags.
- C. Related Sections:
  - 1. Division 26 Section "Exterior Lighting" for site lighting fixtures.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Flagpole assemblies, including anchorages and supports, shall withstand the effects of gravity loads, and the following loads and stresses within limits and under conditions indicated according to the following design criteria:
  - 1. Seismic Loads: According to SEI/ASCE 7.
  - 2. Wind Loads: 180 mph and 1 according to NAAMM FP 1001, "Guide Specifications for Design of Metal Flagpoles."
  - 3. Base flagpole design on nylon flags of maximum standard size suitable for use with flagpole or flag size indicated, whichever is more stringent.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, operating characteristics, fittings, accessories, and finishes for flagpoles.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain flagpole as complete unit, including fittings, accessories, bases, and anchorage devices, from single source from single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. General: Spiral wrap flagpoles with heavy paper and enclose in a hard fiber tube or other protective container.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements:
  - 1. American Flagpole, a Kearney-National Inc. company.
  - 2. Pole-Tech Company Inc.
  - 3. U.S. Flag & Flagpole Supply, LP.

2.2 FLAGPOLES FP

- A. Flagpole Construction, General: Construct flagpoles in one piece if possible. If more than one piece is necessary, comply with the following:
  - 1. Fabricate shop and field joints without using fasteners, screw collars, or lead calking.
  - 2. Provide flush hairline joints using self-aligning, snug-fitting, internal sleeves.
  - 3. Provide self-aligning, snug-fitting joints.
- B. Exposed Height: 25 feet.

2.3 FITTINGS

- A. Finial Ball (FB): Manufacturer's standard flush-seam ball, sized as indicated or, if not indicated, to match flagpole-butt diameter.
  - 1. 0.063-inch spun aluminum, finished to match flagpole.
- B. External Halyard (EH): Ball-bearing, nonfouling, revolving truck assembly of cast metal with continuous 5/16-inch- diameter, braided polypropylene halyard and 9-inch cast-metal cleats with fasteners. Finish exposed metal surfaces to match flagpole.
  - 1. Provide two halyards and two cleats at each flagpole.
  - 2. Provide cast-metal cleat covers, finished to match flagpole, secured with cylinder locks.
  - 3. Halyard Flag Snaps: Provide two stainless-steel swivel snap hooks per halyard.
    - a. Provide with neoprene or vinyl covers.
  - 4. Plastic Halyard Flag Clips: Made from injection-molded, UV-stabilized, acetal resin (Delrin). Clips attach to flag and have two eyes for inserting both runs of halyards. Provide two flag clips per halyard.
    - a. Product: Subject to compliance with requirements, provide "Quiet Halyard" flag clasp by Lingo.

2.4 GENERAL FINISH REQUIREMENTS

- A. Comply with N AAMM's " Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

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- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.5 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, including foundation; accurate placement, pattern, orientation of anchor bolts, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 FLAGPOLE INSTALLATION

- A. General: Install flagpoles where shown and according to Shop Drawings and manufacturer's written instructions.

END OF SECTION 107500

SECTION 113100 - RESIDENTIAL APPLIANCES

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. Cooking equipment including:

- a. Microwave ovens.

- 2. Refrigerator/freezers.

- 3. Cleaning appliances:

- a. Dishwashers.

- B. Owner-Furnished Material.

- C. Related Sections include the following:

- 1. Division 06 Section "Interior Architectural Woodwork" for custom-made cabinets and plastic-laminate tops that receive residential appliances.
  - 2. Division 12 Section "Residential Casework" for standard cabinets and countertops that receive residential appliances.
  - 3. Division 22 Section "Domestic Water Piping" for water distribution piping connections to residential appliances.
  - 4. Division 22 Section "Sanitary Waste and Vent Piping" for drainage and vent piping connections to residential appliances.
  - 5. Division 22 Section "Plumbing Fixtures" for kitchen sinks, waste disposers, and instant hot-water dispensers.
  - 6. Division 26 Section "Low-Voltage Electrical Power Conductors and Cables" for services and connections to residential appliances.

1.3 SUBMITTALS

- A. Appliance Schedule: For appliances; use same designations indicated on Drawings.
- B. Maintenance Data: For each product to include in maintenance manuals.
- C. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

- A. **Installer Qualifications:** An employer of workers trained and approved by manufacturer for installation and maintenance of units required for this Project.
- B. **Source Limitations:** Obtain residential appliances through one source from a single manufacturer.
  - 1. Provide products from same manufacturer for each type of appliance required.
  - 2. To the greatest extent possible, provide appliances by a single manufacturer for entire Project.
- C. **Product Options:** Information on Drawings and in Specifications establishes requirements for product's aesthetic effects and performance characteristics. 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. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
- D. **Regulatory Requirements:** Comply with provisions of the following product certifications:
  - 1. NFPA: Provide electrical appliances listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
  - 2. UL and NEMA: Provide electrical components required as part of residential appliances that are listed and labeled by UL and that comply with applicable NEMA standards.
  - 3. NAECA: Provide residential appliances that comply with NAECA standards.
- E. **Regulatory Requirements, Accessibility:** Where residential appliances are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."
  - 1. **Operable Parts:** Provide controls with forward reach no higher than 48 inches above the floor, horizontal front reach no more than 25 inches, horizontal side reach no more than 24 inches, and 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. **Refrigerator/Freezer:** Provide 50 percent of freezer space within 54 inches of the floor.
- F. **AHAM Standards:** Provide appliances that comply with the following AHAM standards:
  - 1. Dishwashers: AHAM DW-DW1.
  - 2. Household Refrigerators: AHAM HRF-1.
  - 3. Household Freezers: AHAM HRF-1.
- G. **Energy Ratings:** Provide residential appliances that carry labels indicating energy-cost analysis (estimated annual operating costs) and efficiency information as required by the FTC Appliance Labeling Rule.

## 1.5 WARRANTY

- A. **Special Warranties:** Manufacturer's standard form in which manufacturer of each appliance specified agrees to repair or replace residential appliances or components that fail in materials or workmanship within specified warranty period.
  - 1. Microwave Oven: Five-year limited warranty for defects in the magnetron tube.
  - 2. Refrigerator/Freezer: Five-year limited warranty for in-home service on the sealed refrigeration system.
  - 3. Dishwasher: 10-year warranty for in-home service against deterioration of tub and door liner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Product: The design for each residential appliance is based on the product named.

2.2 COOKING APPLIANCES

A. Microwave Oven:

1. Product: As indicated on Drawings.
2. Oven(s): Standard features include the following:
  - a. Oven Capacity: 2.0 cu. ft..
  - b. Oven Features: Digital control panel with timer display, glass turntable, and child lock-out.
  - c. Mounting: Countertop.
  - d. Electrical Power: 1200 W.
  - e. Oven Door: Counter-balanced, removable, porcelain enamel black on black; case color – grey stone finish, black observation window.

2.3 REFRIGERATION APPLIANCES

A. Refrigerator/Freezer:

1. Product: As indicated on Drawings.
2. Type: Freestanding, frost-free, side-by-side refrigerator/freezer.
3. Storage Capacity:
  - a. Fresh Food Compartment Volume: 15.9 cu. ft..
  - b. Freezer Volume: 9.49 cu. ft..
- c. Shelf Area: Adjustable 4 Glass shelves, 1 quick space and 3 adjustable, 23.10 sq. ft.
4. Refrigerator Features:
  - a. Compartment Storage: Vegetable crisper, Bottom drawer, Snack drawer, Freshness Center
  - b. Door Storage: Gallon Door Storage; Fresh Food Door Bins.
  - c. Interior light in each compartment.
5. Freezer Features:
  - a. Ice storage bins.
  - b. Automatic icemaker and storage bin.
  - c. Circulator fan.
  - d. Ice and cold-water dispenser in the door.

6. Energy Consumption: Measured and certified by AHAM HRF-1 at not more than 1100 watts Energy Star Qualified 688kWh/year under average conditions for a refrigerated volume of 15.46 cu.ft.
7. Temperature Controls: Separate temperature controls for each compartment.
8. Front Panel: Reversible panels with choice of colors for door front and lower access panel.
  - a. Panel Color: Black.
9. Appliance Color: Black.

## 2.4 CLEANING APPLIANCES

### A. Dishwasher:

1. Product: As indicated on Drawings.
2. Type: Under the counter, 24 inches wide, operable at water pressures from 15 to 120 psi.
3. Tub and Door Liner: Stainless steel.
  - a. Detergent Dispenser: Sealed detergent and automatic rinsing-aid dispensers in door liner.
4. Rack System: Nylon-coated sliding dish racks, with one piece super with 1 cell cover.
5. Operation: Five wash cycles with hot-air and heat-off drying cycle options.
6. Controls: 9 Touch pads.
7. Front Panel: Manufacturer's standard.
  - a. Panel Color: Black.
8. Appliance Color: Black.
9. Optional features include the following:
  - a. LED display panel.

## 2.5 FINISHES, GENERAL

- 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. Stainless-Steel Finish: Provide appliances with manufacturer's standard finish complying with manufacturer's written instructions for surface preparation including ground and polished stainless-steel surfaces for uniform, directionally textured finish.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

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- B. Examine roughing-in for piping systems to verify actual locations of piping connections before equipment installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. General: Comply with manufacturer's written instructions.
- B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and rough openings are completely concealed.
- C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.
- D. Utilities: Refer to Divisions 22 and 26 for plumbing and electrical requirements.

### 3.3 CLEANING AND PROTECTION

- A. Test each item of residential appliances to verify proper operation. Make necessary adjustments.
- B. Verify that accessories required have been furnished and installed.
- C. Remove packing material from residential appliances and leave units in clean condition, ready for operation.

### 3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain residential appliances. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 113100



SECTION 124813 - ENTRANCE FLOOR MATS AND FRAMES

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. Recessed mats in frames.

1.3 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Maintenance Data: For floor mats to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain floor mats through one source from a single manufacturer.
- B. Accessibility Requirements: Provide installed floor mats that comply with Section 4.5 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."

1.5 PROJECT CONDITIONS

- A. Field Measurements: Indicate measurements on Shop Drawings.

1.6 COORDINATION

- A. Coordinate size and location of recesses in concrete with installation of finish floors to receive floor mats.

PART 2 - PRODUCTS

2.1 RECESSED MATS, RM1.

- A. Manufacturer: C/S Group.

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- B. Mill finish aluminum tread rails with carpet tread inserts, 1 1/2" wide, with slotted or perforated vinyl hinges.
  - 1. Tread Inserts: Carpet tread inserts.
  - 2. Colors, Textures, and Patterns of Inserts: As indicated on drawings.
  - 3. Rail Color: As indicated on drawings.
  - 4. Mat Size: As indicated on drawings.

## 2.2 FABRICATION

- A. Floor Mats: Shop fabricate units to greatest extent possible in sizes indicated. Unless otherwise indicated, provide single unit for each mat installation; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes. Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and floor conditions for compliance with requirements for location, sizes, and other conditions affecting installation of floor mats and frames.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install surface-type units to comply with manufacturer's written instructions at locations indicated; coordinate with entrance locations and traffic patterns.

### 3.3 PROTECTION

- A. Maintain protection until construction traffic has ended and Project is near Substantial Completion.

END OF SECTION 124813

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
  - 1. Pipes, fittings, and specialties.
  - 2. Fire-protection valves.
  - 3. Fire-department connections.
  - 4. Sprinklers.
  - 5. Alarm devices.
  - 6. Pressure gages.

1.3 DEFINITIONS

- A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig maximum.

1.4 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.5 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
- B. Delegated Design: Design sprinkler system(s) using performance requirements and design criteria indicated.
- C. Sprinkler system design shall be approved by authorities having jurisdiction.
  - 1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
  - 2. Sprinkler Occupancy Hazard Classifications:
    - a. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
    - b. General Storage Areas: Ordinary Hazard, Group 1.
    - c. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
    - d. Office and Public Areas: Light Hazard.

3. Minimum Density for Automatic-Sprinkler Piping Design:
  - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
  - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
4. Maximum Protection Area per Sprinkler: Per UL listing.
  - a. Office Spaces: 225 sq. ft.
  - b. Storage Areas: 130 sq. ft.
  - c. Mechanical Equipment Rooms: 130 sq. ft.
  - d. Electrical Equipment Rooms: 130 sq. ft.
  - e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
5. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
  - a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
  - b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.

#### 1.6 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
  1. Wiring Diagrams: For power, signal, and control wiring.
- C. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria.
- D. Qualification Data: For qualified Installer and professional engineer.
- E. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- F. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
- G. Field quality-control reports.
- H. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

#### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
  1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems. Base calculations on results of fire-hydrant flow test.
- B. 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.
- D. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
  - 1. NFPA 13, "Installation of Sprinkler Systems."
  - 2. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

## 1.8 COORDINATION

- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

## 1.9 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

## PART 2 - PRODUCTS

### 2.1 PIPING MATERIALS

- A. Comply with requirements in " Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

### 2.2 STEEL PIPE AND FITTINGS

- A. Standard Weight, Black-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.
- B. Schedule 10, Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10, plain end.
- C. Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- D. Malleable- or Ductile-Iron Unions: UL 860.
- E. Cast-Iron Flanges: ASME 16.1, Class 125.
- F. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
- G. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.
- H. Grooved-Joint, Steel-Pipe Appurtenances:

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. Anvil International, Inc.
  - b. Corcoran Piping System Co.
  - c. National Fittings, Inc.
  - d. Shurjoint Piping Products.
  - e. Tyco Fire & Building Products LP.
  - f. Victaulic Company.
2. Pressure Rating: 175 psig minimum.
3. Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

### 2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick .
  1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

### 2.4 LISTED FIRE-PROTECTION VALVES

- A. General Requirements:
  1. Valves shall be UL listed or FM approved.
  2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.
- B. Ball Valves:
  1. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
    - a. Anvil International, Inc.
    - b. Victaulic Company.
  2. Standard: UL 1091 except with ball instead of disc.
  3. Valves NPS 1-1/2 and Smaller: Bronze body with threaded ends.
  4. Valves NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
  5. Valves NPS 3: Ductile-iron body with grooved ends.
- C. Bronze Butterfly Valves:
  1. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:

- a. Global Safety Products, Inc.
  - b. Milwaukee Valve Company.
  - c. Fivalco Inc.
2. Standard: UL 1091.
  3. Pressure Rating: 175 psig.
  4. Body Material: Bronze.
  5. End Connections: Threaded.
- D. Check Valves:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
    - a. AFAC Inc.
    - b. Anvil International, Inc.
    - c. Fire Protection Products, Inc.
    - d. Globe Fire Sprinkler Corporation.
    - e. NIBCO INC.
    - f. Potter Roemer.
    - g. Reliable Automatic Sprinkler Co., Inc.
    - h. Tyco Fire & Building Products LP.
    - i. Victaulic Company.
    - j. Viking Corporation.
  2. Standard: UL 312.
  3. Pressure Rating: 250 psig minimum.
  4. Type: Swing check.
  5. Body Material: Cast iron.
  6. End Connections: Flanged or grooved.
- E. Bronze OS&Y Gate Valves:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
    - a. Milwaukee Valve Company.
    - b. NIBCO INC.
    - c. United Brass Works, Inc.
  2. Standard: UL 262.
  3. Pressure Rating: 175 psig.
  4. Body Material: Bronze.
  5. End Connections: Threaded.
- F. Indicating-Type Butterfly Valves:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
    - a. Anvil International, Inc.
    - b. Global Safety Products, Inc.
    - c. NIBCO INC.
    - d. Tyco Fire & Building Products LP.
    - e. Victaulic Company.

2. Standard: UL 1091.
3. Pressure Rating: 175 psig minimum.
4. Valves NPS 2 and Smaller:
  - a. Valve Type: Ball or butterfly.
  - b. Body Material: Bronze.
  - c. End Connections: Threaded.
5. Valves NPS 2-1/2 and Larger:
  - a. Valve Type: Butterfly.
  - b. Body Material: Cast or ductile iron.
  - c. End Connections: Flanged, grooved, or wafer.
6. Valve Operation: Integral electrical, 115-V ac, prewired, single-circuit, supervisory switch indicating device.

## 2.5 TRIM AND DRAIN VALVES

### A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig minimum.

### B. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Affiliated Distributors.
  - b. Anvil International, Inc.
  - c. Barnett.
  - d. Conbraco Industries, Inc.; Apollo Valves.
  - e. Fire-End & Croker Corporation.
  - f. Fire Protection Products, Inc.
  - g. Flowserve.
  - h. FNW.
  - i. Jomar International, Ltd.
  - j. Kennedy Valve; a division of McWane, Inc.
  - k. Kitz Corporation.
  - l. Legend Valve.
  - m. Metso Automation USA Inc.
  - n. Milwaukee Valve Company.
  - o. NIBCO INC.
  - p. Potter Roemer.
  - q. Red-White Valve Corporation.
  - r. Southern Manufacturing Group.
  - s. Stewart, M. A. and Sons Ltd.
  - t. Tyco Fire & Building Products LP.

### C. Globe Valves:



1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Fire Protection Products, Inc.
  - b. United Brass Works, Inc.

## 2.6 SPECIALTY VALVES

### A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating:
  - a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.
3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

### B. Automatic (Ball Drip) Drain Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
  - a. Reliable Automatic Sprinkler Co., Inc.
  - b. Tyco Fire & Building Products LP.
2. Standard: UL 1726.
3. Pressure Rating: 175 psig minimum.
4. Type: Automatic draining, ball check.
5. Size: NPS 3/4.
6. End Connections: Threaded.

## 2.7 BACKFLOW PREVENTERS

### A. Reduced-Pressure-Principle Backflow Preventers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
  - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
  - b. FEBCO; SPX Valves & Controls.
  - c. Watts Water Technologies, Inc.
2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle one-third of flow range.
5. Body Material: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved steel with interior lining complying with AWWA C550 or that is FDA approved or stainless steel for NPS 2-1/2 and larger.
6. End Connections: Flanged or grounded for NPS 2-1/2 and larger.
7. Configuration: Designed for vertical inlet, horizontal center section, and vertical outlet flow.

8. Accessories:
  - a. Valves: OS&Y gate type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
  - b. Air-Gap Fitting: ASME A112.1.2, matching backflow preventer connection.

## 2.8 FIRE-DEPARTMENT CONNECTIONS

### A. Yard-Type, Fire-Department Connection:

1. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:
  - a. Elkhart Brass Mfg. Company, Inc.
  - b. Fire Protection Products, Inc.
  - c. Guardian Fire Equipment, Inc.
  - d. Wilson & Cousins Inc.
  - e. Fire-End & Croker Corporation.
2. Standard: UL 405.
3. Type: Exposed, freestanding.
4. Pressure Rating: 175 psig minimum.
5. Body Material: Corrosion-resistant metal.
6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Round, brass, floor type.
9. Outlet: Bottom, with pipe threads.
10. Number of Inlets: Two.
11. Sleeve: Not required.
12. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE."
13. Finish, Including Sleeve: Rough brass or bronze.
14. Outlet Size: NPS 4.

## 2.9 SPRINKLER SPECIALTY PIPE FITTINGS

### A. Branch Outlet Fittings:

1. Standard: UL 213.
2. Pressure Rating: 175 psig minimum.
3. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
4. Type: Mechanical-T and -cross fittings.
5. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
6. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
7. Branch Outlets: Grooved, plain-end pipe, or threaded.

### B. Flow Detection and Test Assemblies:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig minimum.
3. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.

4. Size: Same as connected piping.
5. Inlet and Outlet: Threaded.

C. Sprinkler Inspector's Test Fittings:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig minimum.
3. Body Material: Cast- or ductile-iron housing with sight glass.
4. Size: Same as connected piping.
5. Inlet and Outlet: Threaded.

D. Flexible, Sprinkler Hose Fittings:

1. Standard: UL 1474.
2. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
3. Pressure Rating: 175 psig minimum.
4. Size: Same as connected piping, for sprinkler.

## 2.10 SPRINKLERS

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating for Automatic Sprinklers: 175 psig minimum.

B. Automatic Sprinklers with Heat-Responsive Element:

1. Nonresidential Applications: UL 199.
2. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

C. Sprinkler Finishes:

1. Chrome plated.
2. Bronze.
3. Painted.

D. Special Coatings:

1. Wax.
2. Lead.
3. Corrosion-resistant paint.

E. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Plastic, white finish, one piece, flat.

F. Sprinkler Guards:

1. Standard: UL 199.
2. Type: Wire cage with fastening device for attaching to sprinkler.

## 2.11 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.
- B. Water-Flow Indicators:
  - 1. Standard: UL 346.
  - 2. Water-Flow Detector: Electrically supervised.
  - 3. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125 -V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
  - 4. Type: Paddle operated.
  - 5. Pressure Rating: 250 psig.
  - 6. Design Installation: Horizontal or vertical.
- C. Valve Supervisory Switches:
  - 1. Standard: UL 346.
  - 2. Type: Electrically supervised.
  - 3. Components: Single-pole, double-throw switch with normally closed contacts.
  - 4. Design: Signals that controlled valve is in other than fully open position.

## 2.12 PRESSURE GAGES

- A. Standard: UL 393.
- B. Dial Size: 3-1/2- to 4-1/2-inch diameter.
- C. Pressure Gage Range: 0 to 250 psig minimum.
- D. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.

## PART 3 - EXECUTION

## 3.1 SERVICE-ENTRANCE PIPING

- A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements for exterior piping in Division 21 Section "Facility Fire-Suppression Water-Service Piping."
- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping.
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

## 3.2 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.
- C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- D. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- G. Install sprinkler piping with drains for complete system drainage.
- H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- I. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.
- J. Install alarm devices in piping systems.
- K. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
- L. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
- M. Fill sprinkler system piping with water.

### 3.3 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
  - 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
- I. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- J. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- K. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.
- L. Plastic-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
  - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

### 3.4 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- D. Specialty Valves:
  - 1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
  - 2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.

### 3.5 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

- B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
- C. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

### 3.6 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

### 3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
  - 4. Energize circuits to electrical equipment and devices.
  - 5. Start and run excess-pressure pumps.
  - 6. Verify that equipment hose threads are same as local fire-department equipment.
- C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.8 PIPING SCHEDULE

- A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
- B. Sprinkler specialty fittings may be used, downstream of control vales, instead of specified fittings.
- C. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller, shall be one of the following:
  - 1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
- D. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 4, shall be one of the following:
  - 1. Schedule 10, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

### 3.9 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:

NFCU

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Pendent sprinklers or Concealed sprinklers as directed.
3. Spaces Subject to Freezing: Pendent, dry sprinklers.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
2. Upright, Pendent Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 211313



SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
  - 1. Piping materials and installation instructions common to most piping systems.
  - 2. Transition fittings.
  - 3. Dielectric fittings.
  - 4. Mechanical sleeve seals.
  - 5. Sleeves.
  - 6. Escutcheons.
  - 7. Grout.
  - 8. Equipment installation requirements common to equipment sections.
  - 9. Painting and finishing.
  - 10. Concrete bases.
  - 11. Supports and anchorages.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe 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 in 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 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 Plumbing 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.

#### 1.5 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.

#### 1.6 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing 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 plumbing 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 the manufacturers specified.

#### 2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 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 22 piping Sections for special joining materials not listed below.
- B. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- C. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- D. Solvent Cements for Joining Plastic Piping:
  - 1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

### 2.4 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
  - 1. Manufacturers:
    - a. Cascade Waterworks Mfg. Co.
    - b. Dresser Industries, Inc.; DMD Div.
    - c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
    - d. JCM Industries.
    - e. Smith-Blair, Inc.
    - f. Viking Johnson.
  - 2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
- B. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
  - 1. Manufacturers:
    - a. NIBCO INC.

### 2.5 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
  - 1. Manufacturers:

- a. Capitol Manufacturing Co.
- b. Central Plastics Company.
- c. Eclipse, Inc.
- d. EpcO Sales, Inc.
- e. Hart Industries, International, Inc.
- f. Watts Industries, Inc.; Water Products Div.
- g. Zurn Industries, Inc.; Wilkins Div.

D. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

1. Manufacturers:

- a. Calpico, Inc.
- b. Lochinvar Corp.

E. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

1. Manufacturers:

- a. Perfection Corp.
- b. Precision Plumbing Products, Inc.
- c. Sioux Chief Manufacturing Co., Inc.
- d. Victaulic Co. of America.

## 2.6 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 NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- 3. Pressure Plates: Carbon steel Stainless steel. Include two for each sealing element.
- 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## 2.7 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. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

D. PVC Pipe: ASTM D 1785, Schedule 40.

## 2.8 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. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
  - 1. Finish: Polished chrome-plated.
- D. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.

## 2.9 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 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 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.
  - 2. Existing Piping: Use the following:
    - a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
- M. Sleeves are not required for core-drilled holes.
- N. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- O. 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. 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.
- P. 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.

- Q. Verify final equipment locations for roughing-in.
- R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

### 3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 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. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- F. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- G. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. PVC Nonpressure Piping: Join according to ASTM D 2855.
- H. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

### 3.3 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. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

### 3.4 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 plumbing 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.

### 3.5 PAINTING

- A. Painting of plumbing 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.

### 3.6 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 plumbing materials and equipment.

### 3.7 GROUTING

- A. Mix and install grout for plumbing 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 220500



SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Sleeves.
  - 2. Sleeve-seal systems.
  - 3. Grout.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. 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. 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 (34.5-MPa), 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.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas **2 inches** above finished floor level.
  - 3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
  - 2. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) 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 Division 07 Section "Joint Sealants."

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 below Grade:
    - a. Piping Smaller Than **NPS 6: Cast-iron wall sleeves with sleeve-seal system.**
      - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.

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2. Concrete Slabs-on-Grade:
  - a. Piping Smaller Than **NPS 6: Cast-iron wall sleeves with sleeve-seal system.**
    - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
3. Interior Partitions:
  - a. Piping Smaller Than **NPS 6 (DN 150): Galvanized-steel-pipe sleeves.**

END OF SECTION 220517

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. This Section includes the following general-duty valves:
  - 1. Bronze angle valves.
  - 2. Copper-alloy ball valves.
  - 3. Bronze check valves.
  - 4. Bronze gate valves.
  - 5. Bronze globe valves.
- B. Related Sections include the following:
  - 1. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and charts.

1.3 DEFINITIONS

- A. The following are standard abbreviations for valves:
  - 1. CWP: Cold working pressure.
  - 2. PTFE: Polytetrafluoroethylene plastic.

1.4 QUALITY ASSURANCE

- A. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.5 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 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 the manufacturers specified.

### 2.2 VALVES, GENERAL

- A. Refer to Part 3 "Valve Applications" Article for applications of valves.
- B. Bronze Valves: NPS 2 and smaller with threaded ends, unless otherwise indicated.
- C. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- D. Valve Sizes: Same as upstream pipe, unless otherwise indicated.
- E. Valve Actuators:
1. Chainwheel: For attachment to valves, of size and mounting height, as indicated in the "Valve Installation" Article in Part 3.
  2. Handwheel: For valves other than quarter-turn types.
  3. Lever Handle: For quarter-turn valves NPS 6 and smaller, except plug valves.
  4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.
- F. Extended Valve Stems: On insulated valves.
- G. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.
- H. Valve Grooved Ends: AWWA C606.
1. Solder Joint: With sockets according to ASME B16.18.
    - a. Caution: Use solder with melting point below 840 deg F for angle, check, gate, and globe valves; below 421 deg F for ball valves.
  2. Threaded: With threads according to ASME B1.20.1.
- I. Valve Bypass and Drain Connections: MSS SP-45.

## 2.3 BRONZE ANGLE VALVES

### A. Manufacturers:

#### 1. Type 2, Bronze Angle Valves with Nonmetallic Disc:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Div.
- d. Grinnell Corporation.
- e. NIBCO INC.

#### B. Bronze Angle Valves, General: MSS SP-80, with ferrous-alloy handwheel.

#### C. Type 2, Class 125, Bronze Angle Valves: Bronze body with nonmetallic disc.

## 2.4 COPPER-ALLOY BALL VALVES

### A. Manufacturers:

#### 1. Two-Piece, Copper-Alloy Ball Valves:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Div.
- d. Grinnell Corporation.
- e. NIBCO INC.
- f. Watts Industries, Inc.; Water Products Div.

#### B. Copper-Alloy Ball Valves, General: MSS SP-110.

#### C. Two-Piece, Copper-Alloy Ball Valves: Bronze body with full-port, chrome-plated bronze ball; PTFE seats; and 600-psig minimum CWP rating and blowout-proof stem.

## 2.5 BRONZE CHECK VALVES

### A. Manufacturers:

#### 1. Type 2, Bronze, Horizontal Lift Check Valves with Nonmetallic Disc:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Div.

#### 2. Type 4, Bronze, Swing Check Valves with Nonmetallic Disc:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Div.
- d. Grinnell Corporation.
- e. NIBCO INC.
- f. Watts Industries, Inc.; Water Products Div.

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- B. Bronze Check Valves, General: MSS SP-80.
- C. Type 2, Class 125, Bronze, Horizontal Lift Check Valves: Bronze body with nonmetallic disc and bronze seat.
- D. Type 4, Class 125, Bronze, Swing Check Valves: Bronze body with nonmetallic disc and bronze seat.

### 2.6 BRONZE GATE VALVES

#### A. Manufacturers:

- 1. Type 1, Bronze, Nonrising-Stem Gate Valves:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Crane Co.; Crane Valve Group; Jenkins Valves.
  - c. Crane Co.; Crane Valve Group; Stockham Div.
  - d. Grinnell Corporation.
  - e. NIBCO INC.
  - f. Watts Industries, Inc.; Water Products Div.
- 2. Type 2, Bronze, Rising-Stem, Solid-Wedge Gate Valves:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Crane Co.; Crane Valve Group; Jenkins Valves.
  - c. Crane Co.; Crane Valve Group; Stockham Div.
  - d. Grinnell Corporation.
  - e. NIBCO INC.

- B. Bronze Gate Valves, General: MSS SP-80, with ferrous-alloy handwheel.
- C. Type 1, Class 125, Bronze Gate Valves: Bronze body with nonrising stem and bronze solid wedge.
- D. Type 2, Class 125, Bronze Gate Valves: Bronze body with rising stem and bronze solid wedge.

### 2.7 BRONZE GLOBE VALVES

#### A. Manufacturers:

- 1. Type 2, Bronze Globe Valves with Nonmetallic Disc:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Crane Co.; Crane Valve Group; Jenkins Valves.
  - c. Crane Co.; Crane Valve Group; Stockham Div.
  - d. Grinnell Corporation.
  - e. NIBCO INC.

- B. Bronze Globe Valves, General: MSS SP-80, with ferrous-alloy handwheel.
- C. Type 2, Class 125, Bronze Globe Valves: Bronze body with nonmetallic PTFE or TFE.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. 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.
- C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. 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.
- F. Do not attempt to repair defective valves; replace with new valves.

### 3.2 VALVE APPLICATIONS

- A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:
  - 1. Shutoff Service: Ball, butterfly valves.
  - 2. Throttling Service: Ball, butterfly, or globe valves.
  - 3. Pump Discharge: Spring-loaded, lift-disc check valves.
- B. If valves with specified CWP ratings are not available, the same types of valves with higher CWP ratings may be substituted.
- C. Domestic Water Piping: Use the following types of valves:
  - 1. Angle Valves, NPS 2 and Smaller: Type 2, Class 150, bronze.
  - 2. Ball Valves, NPS 2 and Smaller: One-piece, 400-psig CWP rating, copper alloy.
  - 3. Lift Check Valves, NPS 2 and Smaller: Type 2, Class 150, horizontal, bronze.
  - 4. Swing Check Valves, NPS 2 and Smaller: Type 4, Class 150, bronze.
  - 5. Gate Valves, NPS 2 and Smaller: Type 1, Class 150, bronze.
  - 6. Globe Valves, NPS 2 and Smaller: Type 2, Class 150, bronze.
- D. Select valves, except wafer and flangeless types, with the following end connections:
  - 1. For Copper Tubing, NPS 2 and Smaller: Solder-joint or threaded ends.
  - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged or threaded ends.
  - 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
  - 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
  - 5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged or threaded ends.

### 3.3 VALVE INSTALLATION



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- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- C. Locate valves for easy access and provide separate support where necessary.
- D. Install valves in horizontal piping with stem at or above center of pipe.
- E. Install valves in position to allow full stem movement.

#### 3.4 JOINT CONSTRUCTION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for basic piping joint construction.
- B. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

#### 3.5 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.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Metal pipe hangers and supports.
2. Metal framing systems.
3. Thermal-hanger shield inserts.
4. Fastener systems.

- B. Related Sections:

1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment 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 plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment..

1.5 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.

2.2 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Cooper B-Line, Inc.
  - b. Flex-Strut Inc.
  - c. 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: Hot-dipped galvanized.
8. Paint Coating: Epoxy.
9. Plastic Coating: Epoxy.

B. Non-MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Anvil International; a subsidiary of Mueller Water Products Inc.
  - b. NIBCO INC.
2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4.
4. Channels: Continuous slotted steel channel with 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.

2.3 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

#### 2.4 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: A STM 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 Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. 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.
- E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- F. 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.
- G. Install lateral bracing with pipe hangers and supports to prevent swaying.
- H. 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.
- I. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- J. 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.
- K. Insulated Piping:

1. Attach clamps and spacers to piping.
  - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
  - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
  - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
  - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
  - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
  - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
  - b. NPS 4: 12 inches long and 0.06 inch thick.
  - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.2 METAL FABRICATIONS

- A. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

### 3.3 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

### 3.4 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

## 3.5 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and attachments for general service applications.
- F. Use padded hangers for piping that is subject to scratching.
- G. Use thermal-hanger shield inserts for insulated piping and tubing.
- H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system 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. 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.
  - 3. 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.
  - 4. 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.
  - 5. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
  - 6. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  - 7. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  - 8. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
  - 9. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
  - 10. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
  - 11. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  - 12. 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.
  - 13. 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.
  - 14. 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.
- I. 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.
- J. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  2. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
- K. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
  2. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  3. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  4. C-Clamps (MSS Type 23): For structural shapes.
  5. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  6. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  7. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  8. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  9. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
  10. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
  11. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  12. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  13. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- L. Saddles and Shields: Unless otherwise indicated and except as specified in piping system 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.
- M. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use powder-actuated fasteners instead of building attachments where required in concrete construction.

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. Pipe labels.
  - 2. Valve tags.

#### 1.3 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

### PART 2 - PRODUCTS

#### 2.1 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 inches.

#### 2.2 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 or Stainless steel, 0.025-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.

### 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 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "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: White.
    - b. Letter Color: Black.

#### 3.3 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:

NFCU

1. Valve-Tag Size and Shape:
  - a. Cold Water: 1-1/2 inches.
  - b. Hot Water: 1-1/2 inches.
  
2. Valve-Tag Color:
  - a. Cold Water: Natural.
  - b. Hot Water: Natural.
  
3. Letter Color:
  - a. Cold Water: White .
  - b. Hot Water: White.

END OF SECTION 220553

## SECTION 220700 - PLUMBING INSULATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Insulation Materials:
    - a. Flexible elastomeric.
    - b. Mineral fiber.
  - 2. Insulating cements.
  - 3. Adhesives.
  - 4. Mastics.
  - 5. Sealants.
  - 6. Factory-applied jackets.
  - 7. Tapes.
- B. Related Sections include the following:
  - 1. Division 23 Section "HVAC Insulation."

#### 1.3 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. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per 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 and inspecting agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

#### 1.4 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.

1.5 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment 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.

1.6 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 Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Aeroflex USA Inc.; Aerocel.
    - b. Armacell LLC; AP Armaflex.
    - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
- D. Mineral-Fiber, Preformed Pipe Insulation:
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Fibrex Insulations Inc.; Coreplus 1200.
    - b. Johns Manville; Micro-Lok.
    - c. Knauf Insulation; 1000(Pipe Insulation.
    - d. Manson Insulation Inc.; Alley-K.
    - e. 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, without factory-applied jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

## 2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Insulco, Division of MFS, Inc.; Triple I.
    - b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.

## 2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Flexible Elastomeric: 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.; Aeroseal.
    - b. Armacell LCC; 520 Adhesive.
    - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
    - d. RBX Corporation; Rubatex Contact Adhesive.
  - 2. For indoor applications, use an adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- 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. Childers Products, Division of ITW; CP-82.
    - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
    - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
    - d. Marathon Industries, Inc.; 225.
    - e. Mon-Eco Industries, Inc.; 22-25.
  - 2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
  - 1. For indoor applications, use mastics that have a VOC content of 12.3 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 and outdoor use on below ambient services.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Products, Division of ITW; CP-35.
    - b. Foster Products Corporation, H. B. Fuller Company; 30-90.

- c. ITW TACC, Division of Illinois Tool Works; CB-50.
  - d. Marathon Industries, Inc.; 590.
  - e. Mon-Eco Industries, Inc.; 55-40.
  - f. Vimasco Corporation; 749.
2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
  3. Service Temperature Range: Minus 20 to plus 180 deg F.
  4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
  5. Color: White.

## 2.5 SEALANTS

### A. Joint Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F.
4. Color: White or gray.
5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 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. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

## 2.7 TAPES

### A. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
  - b. Compac Corp.; 120.
  - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
  - d. Venture Tape; 3520 CW.
2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
  - 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
  - 2. Verify that surfaces to be insulated are clean and dry.
  - 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 equipment and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and 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. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- O. For above ambient services, do not install insulation to the following:
  - 1. Vibration-control devices.
  - 2. Testing agency labels and stamps.
  - 3. Nameplates and data plates.
  - 4. Manholes.
  - 5. Handholes.
  - 6. Cleanouts.

### 3.4 PENETRATIONS

- A. Insulation Installation at Interior Wall and Partition Penetrations ( That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- B. Insulation Installation at Floor Penetrations:
  - 1. Pipe: Install insulation continuously through floor penetrations.
  - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "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, vessels, and equipment. 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 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- 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 bolys, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
  4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
  1. Install mitered sections of pipe insulation.
  2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
  1. Install preformed valve covers manufactured of same material as pipe insulation when available.
  2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  3. Install insulation to flanges as specified for flange insulation application.
  4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.7 MINERAL-FIBER INSULATION INSTALLATION

- 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 but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
  1. Install preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with 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.

### 3.8 FINISHES

A. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. Flat Acrylic Finish: One 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.

### 3.9 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 Cold Water:

1. NPS 1 and Smaller: Insulation shall be the following:
  - a. Flexible Elastomeric: 1 inch thick.
2. NPS 1-1/4 and Larger: Insulation shall be the following:
  - a. Flexible Elastomeric: 1 inch thick.

B. Domestic Hot and Recirculated Hot Water:

1. NPS 1-1/4 and Smaller: Insulation shall be the following:
  - a. Flexible Elastomeric: 1 inch thick.
  - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
2. NPS 1-1/2 and Larger: Insulation shall be the following:
  - a. Flexible Elastomeric: 1 inch thick.
  - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

C. Roof Drain and Overflow Drain Bodies:

1. All Pipe Sizes: Insulation shall be the following:
  - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

END OF SECTION 220700

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, fittings, and specialties inside the building.

1.3 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 61 for potable domestic water piping and components.

1.4 PROJECT CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
  - 1. Notify Owner no fewer than five days in advance of proposed interruption of water service.
  - 2. Do not proceed with interruption of water service without Owner's written permission.

1.5 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

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 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
4. Copper Unions: M SS SP-123, cast-copper-alloy, hexagonal-stock body , with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
5. Copper Pressure-Seal-Joint Fittings:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Elkhart Products Corporation; Industrial Division.
    - 2) NIBCO INC.
    - 3) Viega; Plumbing and Heating Systems.
  - b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
  - c. NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.
6. Copper Push-on-Joint Fittings:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) NVent LLC.
  - b. Description: Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22; with stainless-steel teeth and EPDM-rubber O-ring seal in each end instead of solder-joint ends.
7. Copper-Tube Extruded-Tee Connections:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) T-DRILL Industries Inc.
  - b. Description: Tee formed in copper tube according to ASTM F 2014.

B. Soft Copper Tube: ASTM B 88, Type K.

1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
2. Copper Pressure-Seal-Joint Fittings:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Elkhart Products Corporation; Industrial Division.
    - 2) NIBCO INC.
    - 3) Viega; Plumbing and Heating Systems.
  - b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
  - c. NPS 3 and NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; 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. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, B CuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- E. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Comply with requirements in Division 31 Section "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 copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install underground copper tube in PE encasement according to ASTM A 674 or AWWA C105.
- D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance.
- E. Install shutoff valve immediately upstream of each dielectric fitting.
- F. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for pressure-reducing valves.
- G. Install domestic water piping level without pitch and plumb.
- H. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- I. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- J. 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.

- K. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- L. Install piping adjacent to equipment and specialties to allow service and maintenance.
- M. Install piping to permit valve servicing.
- N. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
- O. Install piping free of sags and bends.
- P. Install fittings for changes in direction and branch connections.
- Q. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

### 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: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Braze Joints" Chapter.
- E. Soldered Joints: 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. Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- G. Copper-Tubing, Push-on Joints: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on-joint fittings by inserting tube to measured depth.
- H. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- I. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

### 3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.
  - 1. Vertical Piping: MSS Type 8 or 42, clamps.



2. Individual, Straight, Horizontal Piping Runs:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet If Indicated: MSS Type 49, spring cushion rolls.
  3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support vertical piping and tubing at base and at each floor.
- C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
  2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
  3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
  4. NPS 2-1/2: 108 inches with 1/2-inch rod.
  5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
- E. Install supports for vertical copper tubing every 10 feet.
- F. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

### 3.5 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
  1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
  2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
  3. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
  4. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

### 3.6 IDENTIFICATION

- A. Identify system components. Comply with requirements in Division 22 Section " Identification for Plumbing Piping and Equipment" for identification materials and installation.
- B. Label pressure piping with system operating pressure.

### 3.7 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 flow of hot water 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.

### 3.8 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. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- 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.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

### 3.9 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. Under-building-slab, domestic water, building service piping, NPS 3 and smaller, shall be the following:
  1. Soft copper tube, ASTM B 88, Type K joints.
- E. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:
  1. Hard copper tube, ASTM B 88, Type M; cast-or wrought-copper solder-joint fittings; and soldered joints.
  2. Hard copper tube, ASTM B 88, Type L or ASTM B 88, Type M; copper pressure-seal-joint fittings; and pressure-sealed joints.
  3. Hard copper tube, ASTM B 88, Type L or ASTM B 88, Type M; copper push-on-joint fittings; and push-on joints.

### 3.10 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 or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
  2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
  3. Hot-Water Circulation Piping, Balancing Duty: Memory-stop balancing valves.
  4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 221116

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Pipe, tube, and fittings.

1.2 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 (30 kPa).

1.3 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.4 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 Owner no fewer than two days in advance of proposed interruption of sanitary waste service.
  - 2. Do not proceed with interruption of sanitary waste service without Owner'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. Sovent Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator and deaerator drainage fittings.
- C. CISPI, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. ANACO-Husky.
  - b. Dallas Specialty & Mfg. Co.
  - c. Fernco Inc.
  - d. Matco-Norca, Inc.
  - e. MIFAB, Inc.
  - f. Mission Rubber Company; a division of MCP Industries, Inc.
  - g. Stant.
  - h. 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.

D. Cast-Iron, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. MG Piping Products Company.
2. Standard: ASTM C 1277.
3. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Division 31 Section "Earth Moving."

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 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. 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.
- K. 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.
- L. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:
  - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 2 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
  - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
  - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- M. 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."
- N. Install engineered soil and waste drainage and vent piping systems as follows:
  - 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
  - 2. Solvent Drainage System: Comply with ASSE 1043 and solvent fitting manufacturer's written installation instructions.
  - 3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
- O. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "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 Division 22 Section "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 Division 22 Section "Escutcheons for Plumbing Piping."

### 3.3 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.
- C. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
- D. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

### 3.4 SPECIALTY PIPE FITTING INSTALLATION

- A. Dielectric Fittings:
  - 1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

### 3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hanger and support devices and installation specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
  - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
  - 2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
  - 3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
  - 4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
  - 5. Vertical Piping: MSS Type 8 or Type 42, clamps.
  - 6. Install individual, straight, horizontal piping runs:
    - a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet (30 m) if Indicated: MSS Type 49, spring cushion rolls.
  - 7. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  - 8. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support horizontal piping and tubing within 12 inches (300 mm) of each fitting, valve, and coupling.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.
- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
  - 2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.

3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
4. Spacing for 10-foot (3-m) lengths may be increased to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).

F. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).

G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 (DN 32): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
2. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
3. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
4. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
5. NPS 3 (DN 80): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.

H. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

### 3.6 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 specified in Division 22 Section "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 (DN 65) and larger.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

### 3.7 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."



## 3.8 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 (30 kPa). 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 (250 Pa). 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.

## 3.9 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

## 3.10 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, vent piping NPS 4 (DN 100) and smaller shall be the following:

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1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
- C. Underground, soil, waste, and vent piping NPS 4 (DN 100) and smaller shall be the following:
1. Hubless, cast-iron soil pipe and fittings; cast-iron hubless-piping couplings; and coupled joints.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following sanitary drainage piping specialties:

1. Cleanouts.
2. Floor drains.

1.2 SUBMITTALS

- A. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.3 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.

1.4 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS

- A. Exposed Metal Cleanouts:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide **the product indicated on Drawings** or a comparable product by one of the following:
  - a. Josam Company; Josam Div.
  - b. MIFAB, Inc.
  - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

- d. Tyler Pipe; Wade Div.
  - e. Watts Drainage Products Inc.
  - f. Zurn Plumbing Products Group; Specification Drainage Operation.
3. Standard: **ASME A112.36.2M for cast iron** for cleanout test tee.
  4. Size: Same as connected drainage piping
  5. Body Material: **Hubless, cast-iron soil pipe test tee** as required to match connected piping.
  6. Closure: **cast-iron** plug.
  7. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
- B. Cast-Iron Wall Cleanouts:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  2. Basis-of-Design Product: Subject to compliance with requirements, provide **the product indicated on Drawings** or a comparable product by one of the following:
    - a. Josam Company; Josam Div.
    - b. MIFAB, Inc.
    - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    - d. Tyler Pipe; Wade Div.
    - e. Watts Drainage Products Inc.
    - f. Zurn Plumbing Products Group; Specification Drainage Operation.
  3. Standard: ASME A112.36.2M. Include wall access.
  4. Size: Same as connected drainage piping.
  5. Body: **Hubless, cast-iron soil pipe test tee** as required to match connected piping.
  6. Closure: **Countersunk or raised-head cast-iron** plug.
  7. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
  8. Wall Access: Round, **deep, chrome-plated bronze** cover plate with screw.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
  1. Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
  2. Locate at each change in direction of piping greater than 45 degrees.
  3. Locate at minimum intervals of 50 feet (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
  4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

- E. Install 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 (750 mm) or Less: Equivalent to 1 percent slope, but not less than 1/4-inch (6.35-mm) total depression.
    - b. Radius, 30 to 60 Inches (750 to 1500 mm): Equivalent to 1 percent slope.
    - c. Radius, 60 Inches (1500 mm) or Larger: Equivalent to 1 percent slope, but not greater than 1-inch (25-mm) 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.
- F. Install wood-blocking reinforcement for wall-mounting-type specialties.
- G. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

### 3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### 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 Division 22 Section "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 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. Transition fittings.
  - 3. Dielectric fittings.
  - 4. Mechanical sleeve seals.
  - 5. Sleeves.
  - 6. Escutcheons.
  - 7. Grout.
  - 8. HVAC demolition.
  - 9. Equipment installation requirements common to equipment sections.
  - 10. Painting and finishing.
  - 11. Concrete bases.
  - 12. 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. 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 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.

#### 1.5 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.

#### 1.6 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- B. Coordinate in stallation 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 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. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- C. Brazing Filler Metals: AWS A5.8, B CuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- D. Solvent Cements for Joining Plastic Piping:
  - 1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.4 TRANSITION FITTINGS

- A. Plastic-to-Metal Transition Unions: M SS SP-107, PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
  - 1. Manufacturers:
    - a. NIBCO INC.

2.5 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
  - 1. Manufacturers:
    - a. Capitol Manufacturing Co.
    - b. Central Plastics Company.
    - c. Eclipse, Inc.
    - d. Epco Sales, Inc.
    - e. Hart Industries, International, Inc.
    - f. Watts Industries, Inc.; Water Products Div.
    - g. Zurn Industries, Inc.; Wilkins Div.

2.6 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: Stainless steel. Include two for each sealing element.
  - 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## 2.7 SLEEVES

- A. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- B. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

## 2.8 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, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
  - 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
  - 1. Finish: Polished chrome-plated.
- E. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With exposed-rivet hinge, set screw, and chrome-plated finish.

## 2.9 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 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. Insulated Piping: One-piece, stamped-steel type with spring clips.
    - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
- M. Sleeves are not required for core-drilled holes.
- N. 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.

- O. Verify final equipment locations for roughing-in.
- P. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

### 3.2 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. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. PVC Nonpressure Piping: Join according to ASTM D 2855.

### 3.3 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. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

### 3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

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- 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.

### 3.5 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.

### 3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 5 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.

END OF SECTION 230500

## SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

## 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 requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.
- B. 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 (1000 m) above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

## 2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.

- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
  - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
  - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F.
- J. Code Letter Designation:
  - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
  - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

#### 2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
  - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
  - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
  - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
  - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

#### 2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
  - 1. Permanent-split capacitor.
- 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 230513

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. Fastener systems.
5. Pipe stands.
6. Equipment supports.

B. Related Sections:

1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 23 Section "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. 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.

1.5 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. Copper Pipe Hangers:

1. Description: M SS 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.
  - g. Wesanco, Inc.
2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with 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: Hot-dipped galvanized.
8. Paint Coating: Vinyl.
9. Plastic Coating: PVC.

B. Non-MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Anvil International; a subsidiary of Mueller Water Products Inc.
  - b. Empire Industries, Inc.
  - c. ERICO International Corporation.
  - d. Haydon Corporation; H-Strut Division.
  - e. NIBCO INC.
  - f. PHD Manufacturing, Inc.

g. PHS Industries, Inc.

2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Coating: Zinc.

## 2.4 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

## 2.5 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. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- E. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

- F. 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.
- G. Install lateral bracing with pipe hangers and supports to prevent swaying.
- H. 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.
- I. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- J. 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.
- K. Insulated Piping:
  - 1. Attach clamps and spacers to piping.
    - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
  - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 4. Shield Dimensions for Pipe: Not less than the following:
    - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    - b. NPS 4: 12 inches long and 0.06 inch thick.
    - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
  - 5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.2 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. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- 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 nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- D. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- E. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

- F. Use padded hangers for piping that is subject to scratching.
- G. 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. 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.
  3. 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.
  4. 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.
  5. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
  6. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  7. Adjustable B and Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  8. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  9. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
  10. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
  11. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
  12. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  13. 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.
- H. 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.
- I. 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.
- J. 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.
- K. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- L. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

END OF SECTION 230529

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.
    - b. Variable-air-volume systems.

1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

1.4 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. Certified TAB reports.
- D. Sample report forms.
- E. 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.

## 1.5 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by NEBB or TABB.
  1. TAB Field Supervisor: Employee of the TAB contractor and certified by NEBB or TABB.
  2. TAB Technician: Employee of the TAB contractor and who is certified by NEBB or TABB 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 Architect.
- D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

## 1.6 PROJECT CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

## 1.7 COORDINATION

- A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- B. Perform TAB after leakage and pressure tests on air distribution systems have been satisfactorily completed.

## 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 used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Division 23 Section "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 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 terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- L. Examine operating safety interlocks and controls on HVAC equipment.
- M. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

### 3.2 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.
  - 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 NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems and in this Section."
  - 1. Comply with requirements in ASHRAE 62.1-2004, 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 Division 23 Section "Air Duct Accessories."
  - 3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC 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. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- D. 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.
- E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- F. Verify that motor starters are equipped with properly sized thermal protection.
- G. Check dampers for proper position to achieve desired airflow path.
- H. Check for airflow blockages.
- I. Check condensate drains for proper connections and functioning.
- J. Check for proper sealing of air-handling-unit components.
- K. Verify that air duct system is sealed as specified in Division 23 Section "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. 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.
  5. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
  6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating 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 VARIABLE-AIR-VOLUME SYSTEMS

- A. Pressure-Independent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Balance variable-air-volume systems the same as described for constant-volume air systems.
  2. Set terminal units and supply fan at full-airflow condition.
  3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
  4. Readjust fan airflow for final maximum readings.
  5. Measure operating static pressure at the sensor that controls the supply fan if one is installed, and verify operation of the static-pressure controller.
  6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.
  7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
    - a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.
  8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
    - a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

### 3.7 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.

### 3.8 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

### 3.9 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Measure, adjust, and record the following data for each electric heating coil:
  - 1. Nameplate data.
  - 2. Airflow.
  - 3. Entering- and leaving-air temperature at full load.
  - 4. Voltage and amperage input of each phase at full load and at each incremental stage.
  - 5. Calculated kilowatt at full load.
  - 6. Fuse or circuit-breaker rating for overload protection.
- B. Measure, adjust, and record the following data for each refrigerant coil:
  - 1. Dry-bulb temperature of entering and leaving air.
  - 2. Wet-bulb temperature of entering and leaving air.
  - 3. Airflow.
  - 4. Air pressure drop.
  - 5. Refrigerant suction pressure and temperature.

### 3.10 TOLERANCES

- A. Set HVAC system's air 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.

### 3.11 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. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:
  - a. Unit identification.
  - b. Location.
  - c. Make and type.
  - d. Model number and unit size.
  - e. Manufacturer's serial number.
  - f. Unit arrangement and class.
  - g. Discharge arrangement.
  - h. Sheave make, size in inches, and bore.
  - i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
  - j. Number, make, and size of belts.
  - k. Number, type, and size of filters.
2. Motor Data:
  - a. Motor make, and frame type and size.
  - b. Horsepower and rpm.
  - c. Volts, phase, and hertz.
  - d. Full-load amperage and service factor.

- e. Sheave make, size in inches, and bore.
- f. Center-to-center dimensions of sheave, and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

- a. Total air flow rate in cfm.
- b. Total system static pressure in inches wg.
- c. Fan rpm.
- d. Discharge static pressure in inches wg.
- e. Filter static-pressure differential in inches wg.
- f. Cooling-coil static-pressure differential in inches wg.
- g. Heating-coil static-pressure differential in inches wg.
- h. Outdoor airflow in cfm.
- i. Return airflow in cfm.
- j. Outdoor-air damper position.
- k. Return-air damper position.

E. Apparatus-Coil Test Reports:

1. Test Data (Indicated and Actual Values):

- a. Air flow rate in cfm.
- b. Average face velocity in fpm.
- c. Air pressure drop in inches wg.
- d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
- e. Return-air, wet- and dry-bulb temperatures in deg F.
- f. Entering-air, wet- and dry-bulb temperatures in deg F.
- g. Leaving-air, wet- and dry-bulb temperatures in deg F.
- h. Refrigerant expansion valve and refrigerant types.
- i. Refrigerant suction pressure in psig.
- j. Refrigerant suction temperature in deg F.

2. Test Data (Indicated and Actual Values):

- a. Total air flow rate in cfm.
- b. Entering-air temperature in deg F.
- c. Leaving-air temperature in deg F.
- d. Air temperature differential in deg F.
- e. Entering-air static pressure in inches wg.
- f. Leaving-air static pressure in inches wg.
- g. Air static-pressure differential in inches wg.
- h. Low-fire fuel input in Btu/h.
- i. High-fire fuel input in Btu/h.
- j. Manifold pressure in psig.
- k. High-temperature-limit setting in deg F.
- l. Operating set point in Btu/h.
- m. Motor voltage at each connection.
- n. Motor amperage for each phase.
- o. Heating value of fuel in Btu/h.

F. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:

1. Unit Data:

- a. System identification.
- b. Location.
- c. Coil identification.
- d. Capacity in Btu/h.
- e. Number of stages.
- f. Connected volts, phase, and hertz.
- g. Rated amperage.
- h. Air flow rate in cfm.
- i. Face area in sq. ft..
- j. Minimum face velocity in fpm.

2. Test Data (Indicated and Actual Values):

- a. Heat output in Btu/h.
- b. Air flow rate in cfm.
- c. Air velocity in fpm.
- d. Entering-air temperature in deg F.
- e. Leaving-air temperature in deg F.
- f. Voltage at each connection.
- g. Amperage for each phase.

G. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

- a. System identification.
- b. Location.
- c. Make and type.
- d. Model number and size.
- e. Manufacturer's serial number.
- f. Arrangement and class.
- g. Sheave make, size in inches, and bore.
- h. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Motor Data:

- a. Motor make, and frame type and size.
- b. Horsepower and rpm.
- c. Volts, phase, and hertz.
- d. Full-load amperage and service factor.
- e. Sheave make, size in inches, and bore.
- f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
- g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

- a. Total airflow rate in cfm.
- b. Total system static pressure in inches wg.
- c. Fan rpm.
- d. Discharge static pressure in inches wg.
- e. Suction static pressure in inches wg.

H. Round 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.

I. Air-Terminal-Device Reports:

1. Unit Data:
  - a. System and air-handling unit identification.
  - b. Location and zone.
  - c. Apparatus used for test.
  - d. Area served.
  - e. Make.
  - f. Number from system diagram.
  - g. Type and model number.
  - h. Size.
  - i. Effective area in sq. ft..
2. Test Data (Indicated and Actual Values):
  - a. Air flow rate in cfm.
  - b. Air velocity in fpm.
  - c. Preliminary air flow rate as needed in cfm.
  - d. Preliminary velocity as needed in fpm.
  - e. Final air flow rate in cfm.
  - f. Final velocity in fpm.
  - g. Space temperature in deg F.

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 230593

SECTION 230700 - HVAC INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Insulation Materials:
  - a. Flexible elastomeric.
  - b. Mineral fiber.
- 2. Fire-rated insulation systems.
- 3. Insulating cements.
- 4. Adhesives.
- 5. Mastics.
- 6. Sealants.
- 7. Field-applied jackets.
- 8. Tapes.

- B. Related Sections:

- 1. Division 22 Section "Plumbing Insulation."
- 2. Division 23 Section "Metal Ducts" for duct liners.

1.3 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. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per 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 and inspecting agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.4 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.

#### 1.5 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

#### 1.6 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 Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Aeroflex USA Inc.; Aerocel.
    - b. Armacell LLC; AP Armaflex.
    - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
- G. 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.; Duct Wrap.
- b. Johns Manville; Microlite.
- c. Knauf Insulation; Duct Wrap.
- d. Manson Insulation Inc.; Alley Wrap.
- e. Owens Corning; All-Service Duct Wrap.

H. 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 ASJ. For equipment applications, provide insulation with factory-applied ASJ. 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 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Insulco, Division of MFS, Inc.; Triple I.
- b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.

B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Insulco, Division of MFS, Inc.; SmoothKote.
- b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
- c. Rock Wool Manufacturing Company; Delta One Shot.

## 2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Flexible Elastomeric 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.; Aeroseal.
- b. Armacell LCC; 520 Adhesive.
- c. Foster Products Corporation, H. B. Fuller Company; 85-75.
- d. RBX Corporation; Rubatex Contact Adhesive.

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. Childers Products, Division of ITW; CP-82.
- b. Foster Products Corporation, H. B. Fuller Company; 85-20.
- c. ITW TACC, Division of Illinois Tool Works; S-90/80.
- d. Marathon Industries, Inc.; 225.
- e. Mon-Eco Industries, Inc.; 22-25.

D. ASJ Adhesive, and FSK and PVDC 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 Products, Division of ITW; CP-82.
- b. Foster Products Corporation, H. B. Fuller Company; 85-20.
- c. ITW TACC, Division of Illinois Tool Works; S-90/80.
- d. Marathon Industries, Inc.; 225.
- e. Mon-Eco Industries, Inc.; 22-25.

## 2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 12.3 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 and outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Childers Products, Division of ITW; CP-35.
- b. Foster Products Corporation, H. B. Fuller Company; 30-90.
- c. ITW TACC, Division of Illinois Tool Works; CB-50.
- d. Marathon Industries, Inc.; 590.
- e. Mon-Eco Industries, Inc.; 55-40.
- f. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.

3. Service Temperature Range: Minus 20 to plus 180 deg F.

4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.

5. Color: White.

## 2.5 SEALANTS

A. Joint Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.

2. Permanently flexible, elastomeric sealant.

3. Service Temperature Range: Minus 100 to plus 300 deg F.

4. Color: White or gray.

B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Childers Products, Division of ITW; CP-76-8.
- b. Foster Products Corporation, H. B. Fuller Company; 95-44.
- c. Marathon Industries, Inc.; 405.
- d. Mon-Eco Industries, Inc.; 44-05.
- e. Vimasco Corporation; 750.

- 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.

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Childers Products, Division of ITW; CP-76.

- 2. Materials shall be compatible with insulation materials, jackets, and substrates.
- 3. Fire- and water-resistant, flexible, elastomeric sealant.
- 4. Service Temperature Range: Minus 40 to plus 250 deg F.
- 5. Color: White.
- 6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.6 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.

## 2.7 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. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
- b. Compac Corp.; 110 and 111.
- c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
- d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.

- 2. Width: 3 inches.
- 3. Thickness: 6.5 mils.
- 4. Adhesion: 90 ounces force/inch in width.
- 5. Elongation: 2 percent.
- 6. Tensile Strength: 40 lbf/inch in width.
- 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
    - b. Compac Corp.; 120.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
    - d. Venture Tape; 3520 CW.
  2. Width: 2 inches.
  3. Thickness: 3.7 mils.
  4. Adhesion: 100 ounces force/inch in width.
  5. Elongation: 5 percent.
  6. Tensile Strength: 34 lbf/inch in width.
- C. PVDC Tape for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.
  2. Width: 3 inches.
  3. Film Thickness: 4 mils.
  4. Adhesive Thickness: 1.5 mils.
  5. Elongation at Break: 145 percent.
  6. Tensile Strength: 55 lbf/inch in width.
- D. PVDC Tape for Outdoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Chemical Company (The); Saran 560 Vapor Retarder Tape.
  2. Width: 3 inches.
  3. Film Thickness: 6 mils.
  4. Adhesive Thickness: 1.5 mils.
  5. Elongation at Break: 145 percent.
  6. Tensile Strength: 55 lbf/inch in width.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
  1. Verify that systems and equipment to be insulated have been tested and are free of defects.
  2. Verify that surfaces to be insulated are clean and dry.
  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 equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and 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 a adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.



- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  - 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
  - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
  - 1. Vibration-control devices.
  - 2. Testing agency labels and stamps.
  - 3. Nameplates and data plates.
  - 4. Manholes.
  - 5. Handholes.
  - 6. Cleanouts.

### 3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at 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.

### 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, 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 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.
  6. 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.
  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, vessels, and equipment. 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 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
  1. Install pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
  4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
  1. Install mitered sections of pipe insulation.
  2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
  1. Install preformed valve covers manufactured of same material as pipe insulation when available.
  2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  3. Install insulation to flanges as specified for flange insulation application.
  4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.7 MINERAL-FIBER INSULATION INSTALLATION

- 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 but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
  4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
  2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
  2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
  3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  4. Install insulation to flanges as specified for flange insulation application.
- E. 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 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier

consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

- a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
  - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, a long butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
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.
- F. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and 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 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, a long butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
  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.

### 3.8 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
  1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
  2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
  3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
  1. Draw jacket material smooth and tight.
  2. Install lap or joint strips with same material as jacket.
  3. Secure jacket to insulation with manufacturer's recommended adhesive.
  4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
  5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
  1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

### 3.9 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.
- C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 07 Section "Penetration Firestopping."

### 3.10 FINISHES

- A. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
  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.

3.11 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 nonconditioned space.
  - 4. Indoor, exposed return located in nonconditioned space.
  - 5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
  - 6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
- 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.

3.12 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, round and flat-oval, supply-air duct insulation shall be the following:
  - 1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft nominal density.
- B. Concealed, rectangular, supply-air duct insulation shall be one of the following:
  - 1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.
- C. Concealed, rectangular, return-air duct insulation shall be the following:
  - 1. Mineral-Fiber Blanket: 1-1/2 inches nominal density.
- D. Concealed, rectangular, outdoor-air duct insulation shall be the following:
  - 1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.
- E. Concealed, rectangular, exhaust-air duct insulation between isolation damper and penetration of building exterior shall be the following:
  - 1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.
- F. Concealed, supply-air plenum insulation shall be the following:
  - 1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.

- G. Concealed, return-air plenum insulation shall be the following:
  - 1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.
- H. Concealed, exhaust-air plenum insulation shall be the following:
  - 1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.

### 3.13 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.

### 3.14 INDOOR PIPING INSULATION SCHEDULE

- A. Condensate and Equipment Drain Water below 60 Deg F:
  - 1. All Pipe Sizes: Insulation shall be the following:
    - a. Flexible Elastomeric: 3/4 inch thick.
- B. Refrigerant Suction and Hot-Gas Flexible Tubing:
  - 1. All Pipe Sizes: Insulation shall be the following:
    - a. Flexible Elastomeric: 1 inch thick.

### 3.15 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Refrigerant Suction and Hot-Gas Flexible Tubing:
  - 1. All Pipe Sizes: Insulation shall be the following:
    - a. Flexible Elastomeric: 2 inches thick.

### 3.16 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Exposed:



NFCU

1. PVC: 20 mils thick.
2. Aluminum, Corrugated with Z-Shaped Locking Seam thick.

END OF SECTION 230700

SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
  - 1. Condensate-drain piping.
- B. Related Sections include the following:
  - 1. Division 23 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.

1.3 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:
  - 1. Condensate-Drain Piping: 150 deg F.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. DWV Copper Tubing: ASTM B 306, Type DWV.

2.2 PLASTIC PIPE AND FITTINGS

- A. PVC Plastic Pipe: ASTM D 1785, Schedules 40 and 80, plain ends as indicated in Part 3 "Piping Applications" Article.
- B. PVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM D 2466 for Schedule 40 pipe; ASTM D 2467 for Schedule 80 pipe.

2.3 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

B. Solvent Cements for Joining Plastic Piping:

1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
  - a. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - b. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.4 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Charlotte Pipe and Foundry Company.
  - b. IPEX Inc.
  - c. KBI.
2. PVC one-piece fitting with one threaded brass or copper insert and one Schedule 80 solvent-cement-joint end.

## PART 3 - EXECUTION

### 3.1 PIPING APPLICATIONS

- A. Condensate-Drain Piping: Type DWV, or Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.

### 3.2 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping at indicated slopes.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.

- H. Install piping to allow application of insulation.

### 3.3 HANGERS AND SUPPORTS

- A. Hanger, supports, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.
- B. Install the following pipe attachments:
  - 1. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.
- C. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
- D. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

### 3.4 PIPE JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. PVC Pressure Piping: Join ASTM D 1785 schedule number, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule number PVC pipe and socket fittings according to ASTM D 2855.
  - 3. PVC Nonpressure Piping: Join according to ASTM D 2855.

END OF SECTION 232113

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-22:
  - 1. Suction Lines for Air-Conditioning Applications: 185 psig.
  - 2. Hot-Gas and Liquid Lines: 325 psig.
- B. 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 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."

1.5 PRODUCT STORAGE AND HANDLING

- A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

1.6 COORDINATION

- A. Coordinate size and location of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B 88, Type K or L or ASTM B 280, Type ACR.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- E. Brazing Filler Metals: AWS A5.8.

2.2 REFRIGERANTS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Atofina Chemicals, Inc.
  - 2. DuPont Company; Fluorochemicals Div.
  - 3. Honeywell, Inc.; Genetron Refrigerants.
  - 4. INEOS Fluor Americas LLC.
- C. ASHRAE 34, R-22: Monochlorodifluoromethane.
- D. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-22

- A. Suction Lines NPS 1-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.

3.2 PIPING APPLICATIONS FOR REFRIGERANT R-410A

- A. Suction Lines NPS 1-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.
- B. Suction Lines NPS 3-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR L, drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
- C. Hot-Gas and Liquid Lines: Copper, Type ACR L, annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
- D. Hot-Gas and Liquid Lines: Copper, Type K, annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.

- E. Hot-Gas and Liquid Lines: Copper, Type ACR K L, drawn-temper tubing and wrought-copper fittings with 95-5 tin-antimony soldered joints.
- F. Hot-Gas and Liquid Lines: Copper, Type ACR K L, drawn-temper tubing and wrought-copper fittings with Alloy HB soldered joints.
- G. Hot-Gas and Liquid Lines:
  - 1. NPS 5/8 and Smaller: Copper, Type ACR L, annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
  - 2. NPS 3/4 to NPS 1 and Smaller: Copper, Type K, annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
  - 3. NPS 1-1/4 and Smaller: Copper, Type ACR K L, drawn-temper tubing and wrought-copper fittings with 95-5 tin-antimony soldered joints.
  - 4. NPS 1-1/2 to NPS 2: Copper, Type ACR K L, drawn-temper tubing and wrought-copper fittings with Alloy HB soldered joints.

### 3.3 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- K. 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 Division 08 Section "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- 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. Install traps and double risers to entrain oil in vertical runs.

- 4. Liquid lines may be installed level.
- M. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- N. Install pipe sleeves at penetrations in exterior walls and floor assemblies.
- O. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- P. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.
- Q. Seal pipe penetrations through exterior walls according to Division 07 Section "Joint Sealants" for materials and methods.

### 3.4 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.
- D. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
- E. 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 BA9, cadmium-free silver alloy for joining copper with bronze or steel.

### 3.5 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor products are specified in Division 23 Section "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. 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.

END OF SECTION 23 2300



## SECTION 233113 - METAL DUCTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Rectangular ducts and fittings.
2. Round ducts and fittings.
3. Sheet metal materials.
4. Sealants and gaskets.
5. Hangers and supports.

B. Related Sections:

1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

#### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

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, 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. Equipment installation based on equipment being used on Project.
10. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
11. Hangers and supports, including methods for duct and building attachment and vibration isolation.

#### 1.4 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 D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum 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 D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
  3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- 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 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 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. Maximum Thermal Conductivity:
    - a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
  - 2. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
- B. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.
  - 1. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
  - 2. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
- C. 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.
- D. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "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 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.
8. 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.

### 2.3 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."
- 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."
- 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."

## 2.4 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: G60 (Z180).
  - 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 (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

## 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. 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 (2500 Pa), positive and negative.
  - 8. Service: Indoor or outdoor.
  - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- C. Round Duct Joint O-Ring Seals:
  - 1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg (0.14 L/s per sq. m at 250 Pa) and shall be rated for 10-inch wg (2500-Pa) static-pressure class, positive or negative.
  - 2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
  - 3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

## 2.6 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- F. Trapeze and Riser Supports:
  - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

## 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 (25 mm), plus allowance for insulation thickness.
- I. Route ducts to a void 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 (38 mm).
- K. 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 all ducts to seal class A according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

### 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 (100 mm) thick.

4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches (610 mm) of each elbow and within 48 inches (1200 mm) 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 (5 m).
- 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 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

### 3.6 DUCT CLEANING

- A. Clean new duct system(s) before testing, adjusting, and balancing.
- B. Use service openings for entry and inspection.
  1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 23 Section "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.

3.7 START UP

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.8 DUCT SCHEDULE

- A. See Drawings

1. Ducts Connected to Variable-Air-Volume Air-Handling Units:
  - a. Pressure Class: Positive 3-inch wg (750 Pa).
  - b. Minimum SMACNA Seal Class: A.
  - c. SMACNA Leakage Class for Rectangular: 3.
  - d. SMACNA Leakage Class for Round and Flat Oval: 3.

2. Ducts Connected to Equipment Not Listed Above:
  - a. Pressure Class: Positive 2-inch wg (500 Pa)
  - b. Minimum SMACNA Seal Class: A.
  - c. SMACNA Leakage Class for Rectangular: 3.
  - d. SMACNA Leakage Class for Round and Flat Oval: 3.
  
- B. Return Ducts:
  1. Ducts Connected to Air-Handling Units:
    - a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 6.
    - d. SMACNA Leakage Class for Round and Flat Oval: 6.
  
  2. Ducts Connected to Equipment Not Listed Above:
    - a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 3.
    - d. SMACNA Leakage Class for Round and Flat Oval: 3.
  
- C. Exhaust Ducts:
  1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
    - a. Pressure Class: Negative 1-inch wg (250 Pa).
    - b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
    - c. SMACNA Leakage Class for Rectangular: 12.
    - d. SMACNA Leakage Class for Round and Flat Oval: 6.
  
- D. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
  1. Ducts Connected to Air-Handling Units:
    - a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 6.
    - d. SMACNA Leakage Class for Round and Flat Oval: 3.
  
- E. Intermediate Reinforcement:
  1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.
  
- F. Elbow Configuration:
  1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

- a. Velocity 1000 fpm (5 m/s) or Lower:
    - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
    - 2) Mitered Type RE 4 without vanes.
  - b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s):
    - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
    - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
    - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
  - c. Velocity 1500 fpm (7.6 m/s) or Higher:
    - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
    - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
    - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
    - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
    - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
    - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
  3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
    - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
      - 1) Velocity 1000 fpm (5 m/s) or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
      - 2) Velocity 1000 to 1500 fpm (5 to 7.6 m/s): 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
      - 3) Velocity 1500 fpm (7.6 m/s) 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 (305 mm) and Smaller in Diameter: Stamped or pleated.
    - c. Round Elbows, 14 Inches (356 mm) and Larger in Diameter: Standing seam.

G. 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: 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 (5 m/s) or Lower: 90-degree tap.
  - b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s): Conical tap.
  - c. Velocity 1500 fpm (7.6 m/s) 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. Turning vanes.
4. Flexible connectors.
5. Flexible ducts.
6. Duct accessory hardware.

B. Related Sections:

1. Division 23 Section "HVAC Gravity Ventilators" for roof-mounted ventilator caps.
2. Division 28 Section "Fire Detection and Alarm" for duct-mounted fire and smoke detectors.

1.3 QUALITY ASSURANCE

- 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 AMCA 500-D testing for damper rating.

1.4 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with S MACNA'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: G60.
  2. Exposed-Surface Finish: Mill phosphatized.
- C. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

## 2.2 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Description: Gravity balanced.
- B. Maximum Air Velocity: 2000 fpm.
- C. Maximum System Pressure: 1-inch wg>.
- D. Frame: 0.063-inch- thick extruded aluminum, with welded corners and mounting flange.
- E. Blades: Multiple single-piece blades, center-pivoted, maximum 6-inch width, 0.025-inch- thick, roll-formed aluminum noncombustible, tear-resistant, neoprene-coated fiberglass with sealed edges.
- F. Blade Action: Parallel.
- G. Blade Seals: Felt.
- H. Blade Axles:
1. Material: Galvanized steel.
  2. Diameter: 0.20 inch.
- I. Tie Bars and Brackets: Aluminum.
- J. Return Spring: Adjustable tension.
- K. Bearings: Synthetic pivot bushings.
- L. Accessories:
1. Electric actuators.
  2. Screen Mounting: Rear mounted.
  3. Screen Material: Aluminum.
  4. Screen Type: Insect.

## 2.3 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:

1. Standard leakage rating, with linkage outside airstream.
2. Suitable for horizontal or vertical applications.
3. Frames:
  - a. Hat-shaped, galvanized-steel channels, 0.064-inch minimum thickness.
  - b. Mitered and welded corners.
  - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
4. 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.
5. Blade Axles: Galvanized steel.
6. 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.
7. Tie Bars and Brackets: Galvanized steel.

B. Jackshaft:

1. Size: 1-inch diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

C. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.4 TURNING VANES

- A. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- B. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."
- C. Vane Construction: Single wall.

2.5 FLEXIBLE CONNECTORS

- A. Materials: Flame-retardant or noncombustible fabrics.

- B. Coatings and Adhesives: Comply with UL 181, Class 1.
- C. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 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.
- D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
  - 1. Minimum Weight: 26 oz./sq. yd..
  - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
  - 3. Service Temperature: Minus 40 to plus 200 deg F.
- E. 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.

## 2.6 FLEXIBLE DUCTS

- A. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.
  - 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
  - 2. Maximum Air Velocity: 4000 fpm.
  - 3. Temperature Range: Minus 10 to plus 160 deg F.
  - 4. Insulation R-value: Comply with ASHRAE/IESNA 90.1-2004.
- B. Flexible Duct Connectors:
  - 1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.

## 2.7 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

## PART 3 - EXECUTION

### 3.1 INSTALLATION



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- 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 or control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
  - 1. Install steel volume dampers in steel ducts.
- 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 flexible connectors to connect ducts to equipment.
- H. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- I. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- J. Connect flexible ducts to metal ducts with draw bands.
- K. Install duct test holes where required for testing and balancing purposes.
- L. 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.

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. This Section includes the following:
  - 1. In-line centrifugal fans.

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 SUBMITTALS

- A. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
- C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- D. UL Standard: Power ventilators shall comply with UL 705.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.
- B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.

- C. Lift and support units with manufacturer's designated lifting or supporting points.

## 1.7 COORDINATION

- A. Coordinate size and location of structural-steel support members.

## PART 2 - PRODUCTS

### 2.1 IN-LINE CENTRIFUGAL FANS (CABINET FANS)

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acme Engineering & Mfg. Corp.
2. American Coolair Corp.
3. Ammerman; General Resource Corp.
4. Bayley Fans; a division of Lau Industries, Inc.
5. Breidert Air Products.
6. Carnes Company HVAC.
7. FloAire.
8. Greenheck.
9. Hartzell Fan, Inc.
10. JencoFan; Div. of Breidert Air Products.
11. Loren Cook Company.
12. Madison Manufacturing.
13. Penn Ventilation.
14. Quietaire Corporation.

- C. Description: In-line, direct-driven centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories.

- D. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

- E. Direct-Driven Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing; with wheel, inlet cone, and motor on swing-out service door.

- F. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.

- G. Accessories:

1. Companion Flanges: For inlet and outlet duct connections.

### 2.2 MOTORS

- A. Comply with requirements in Division 23 Section " Common Motor Requirements for HVAC Equipment."

- B. Enclosure Type: Totally enclosed, fan cooled.

### 2.3 SOURCE QUALITY CONTROL

- A. Sound-Power Level Ratings: Comply with 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. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install power ventilators level and plumb.
- B. Install units with clearances for service and maintenance.
- C. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

### 3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### 3.3 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Refer to Division 23 Section "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 233423

SECTION 233600 - AIR TERMINAL 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. Section Includes:
  - 1. Shutoff, single-duct air terminal units.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1.4 SUBMITTALS

- A. Product Data: For each type of the following products, including rated capacities, furnished specialties, sound-power ratings, and accessories.
  - 1. Air terminal units.
- B. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
  - 1. Instructions for resetting minimum and maximum air volumes.
  - 2. Instructions for adjusting software set points.

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.

PART 2 - PRODUCTS

2.1 SHUTOFF, SINGLE-DUCT AIR TERMINAL UNITS

- A. Basis of Design Product: Subject to compliance with requirements, provide products indicated on the drawings.

- B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.
- C. Casing: 0.034-inch steel single wall.
  - 1. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
  - 2. Air Outlet: S-slip and drive connections.
  - 3. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
- D. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
  - 1. Maximum Damper Leakage: ARI 880 rated, 2 percent of nominal airflow at 3-inch wg inlet static pressure.
  - 2. Damper Position: Normally closed.
- E. Electric Controls: Damper actuator and thermostat.
  - 1. Damper Actuator: 24 V, powered closed, powered open.
  - 2. Thermostat: Wall-mounted electronic type with clock display, temperature display in Fahrenheit and Celsius, and space temperature set point.
- F. Control Sequence:
  - 1. Suitable for operation with duct pressures between 0.25- and 3.0-inch wg inlet static pressure.
  - 2. System-powered, wall-mounted thermostat.

## 2.2 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. Air Terminal Unit Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- D. Trapeze and Riser Supports: Steel shapes and plates for units with steel casings; aluminum for units with aluminum casings.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.
- C. Install wall-mounted thermostats.

### 3.2 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "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 and for slabs more than 4 inches thick.
  - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than 4 inches thick.
- C. Hangers Exposed to View: Threaded rod and angle or channel supports.
- D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### 3.3 CONNECTIONS

- A. Connect ducts to air terminal units according to Division 23 Section "Metal Ducts."

### 3.4 IDENTIFICATION

- A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

### 3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Tests and Inspections:
  - 1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
  - 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.
- C. Air terminal unit will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.

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1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
3. Verify that controls and control enclosure are accessible.
4. Verify that control connections are complete.
5. Verify that nameplate and identification tag are visible.
6. Verify that controls respond to inputs as specified.

### 3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

END OF SECTION 233600



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. Rectangular and square ceiling diffusers.
- 2. Louver face diffusers.
- 3. Linear slot diffusers.
- 4. Fixed face grilles.

- B. Related Sections:

- 1. Division 23 Section " Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 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.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

- A. Rectangular and Square Ceiling Diffusers :

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Price Industries.
  - b. Titus.
- 2. Devices shall be specifically designed for variable-air-volume flows.

2.2 CEILING LINEAR SLOT OUTLETS

A. Linear Slot Diffuser :

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Price Industries.
  - b. Titus.

2.3 REGISTERS AND GRILLES

A. Fixed Face Grille (Egg Crate)>:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Price Industries.
  - b. Titus.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

## SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Wiring Diagrams: For power, signal, and control wiring.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

#### 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 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.
- D. The units shall be rated in accordance with Air-Conditioning, Heating, and Refrigeration Institute's (AHRI) Standard 210 and bear the ARI Certification label.
- E. The units shall be manufactured in a facility registered to ISO 9001 and ISO 14001, which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).
- F. A dry air holding charge shall be provided in the indoor section.

## 1.6 COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

## 1.7 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: Five year(s) from date of Substantial Completion.
    - c. For Labor: Five year(s) from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings.

### 2.2 INDOOR UNITS (5 TONS OR LESS)

- A. Concealed Evaporator-Fan Components (AHU-3/HP-3):
  - 1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
  - 2. Insulation: Faced, glass-fiber duct liner.
  - 3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 210/240.
  - 4. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors,

manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.

5. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
6. Fan Motors:
  - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
  - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
  - c. Wiring Terminations: Connect motor to chassis wiring with plug connection.
7. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
8. Filters: Permanent, cleanable.
9. 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 to direct water toward drain connection.
    - 1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
  - 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 both ends of pan.
    - 1) Minimum Connection Size: NPS 3/4.

B. Concealed Evaporator-Fan Components (AC-1/ACCU-1):

1. Cabinet:
  - a. The indoor unit cabinet shall be a space-saving ceiling-recessed cassette type. The cabinet shall be formed from galvanized sheet metal coated with high-density foam insulation. The indoor unit shall be factory assembled, wired and tested. Contained within the unit shall be all factory wiring and internal piping, condensate lift mechanism, control circuit board, fan, and fan motor. Single branch ducting shall be allowed from cabinet. The cabinet panel shall have provisions for a field installed filtered outside air intake.
  - b. A separate grill assembly shall be attached to the front of the cabinet to provide supply air vanes in four directions and a center mounted return air section. The four-way grill shall be fixed to bottom of cabinet allowing two, three or four-way blow. The grill vane angles shall be individually adjustable from the wired remote controller to customize the airflow pattern for the conditioned space. Grill assembly color shall be Munsell 6.4Y 8.9/0.4
  - c. The unit, in conjunction with the wired, wall-mounted controller shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function.

Indoor unit and integral refrigerant pipes shall be purged with dry nitrogen and capped before shipment from the factory.

2. Coil: The indoor unit coil shall be of nonferrous construction with pre-coated aluminum strake fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. The heat exchanger shall have a modified fin shape that reduces air resistance for a smoother, quieter airflow. All tube joints shall be brazed with PhosCopper or silver alloy. The coils shall be pressure tested at the factory.
3. Fan
  - a. The indoor fan shall be an assembly with a turbo fan propeller, direct driven by a single motor and shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings. The indoor fan shall consist of five (5) speed settings, Low, Mid1, Mid2, High and Auto. The fan shall have a selectable Auto fan setting that will adjust the fan speed based on the difference between controller set-point and space temperature.
  - b. Vane: The indoor unit shall have an adjustable air outlet system offering 4-way airflow, 3-way airflow, or 2-way airflow with switches that can be set to provide optimum airflow based on ceiling height and number of outlets used. The indoor unit vanes shall have 5 fixed positions and a swing feature that shall be capable of automatically swinging the vanes up and down for uniform air distribution. If specified, the grill shall have an optional i-see® sensor that will measure room temperature variations and adjust the airflow accordingly to evenly condition the space.
4. A condensate pan with drain connections shall be provided under the coil. The unit shall also include a built-in, automatic condensate lift mechanism that will be able to raise drain water 33 inches (84 cm) above the condensate pan. The lift mechanism shall be equipped with a positive acting liquid level sensor to shut down the indoor unit if liquid level in the drain pan reached maximum level. Both refrigerant lines between the indoor unit and outdoor unit shall be fully insulated.
5. Filter: Return air shall be filtered by means of easily removable, long life, washable filter.
6. Electrical: The electrical power of the unit shall be 208 / 230 volts, 1-phase, 60 hertz. The system shall be capable of satisfactory operation within voltage limits of 198 volts to 253 volts. The indoor unit shall be provided with A-Control – a system allowing the indoor unit to be powered and controlled directly from the outdoor unit using a 14 gauge (AWG) 3-wire connection plus ground providing both primary power and integrated, bi-directional, digital control signal without additional connections. The indoor units shall not have any supplemental or “back-up” electrical heating elements.

## 2.3 INDOOR UNITS (6 TONS OR MORE)

### A. Concealed Evaporator-Fan Components:

1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
2. Insulation: Faced, glass-fiber duct liner.
3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 210/240.
4. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
5. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
6. 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. Three-phase, permanently lubricated, ball-bearing motors with built-in thermal-overload protection.
  - d. Wiring Terminations: Connect motor to chassis wiring with plug connection.
7. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
8. Filters: 1 inch thick, in fiberboard frames, Permanent, cleanable.
9. 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.
  - 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 both ends of pan.
    - 1) Minimum Connection Size: NPS 3/4.

## 2.4 OUTDOOR UNITS (5 TONS OR LESS)

### A. Air-Cooled, Compressor-Condenser Components (AHU-3/HP-3):

1. Casing: Steel, finished with baked enamel 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. Manual-reset high-pressure switch and automatic-reset low-pressure switch.
  - c. Refrigerant Charge: R-410A .
  - d. Refrigerant C oil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 210/240.
3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
  4. Fan: Aluminum-propeller type, directly connected to motor.
  5. Motor: Permanently lubricated, with integral thermal-overload protection.
  6. Mounting Base: Polyethylene.
- B. General (AC-1/ACCU-1):
1. The outdoor unit shall be compatible with the three different types of indoor units (PKA - wall mounted, PCA - ceiling suspending, and PLA - four way ceiling cassette). The connected indoor unit must be of the same capacity as the outdoor unit.
  2. The outdoor unit shall be equipped with a control board that interfaces with the indoor unit to perform all necessary operation functions. The outdoor unit shall be capable of operating at 0° F (-18°C) ambient temperature without additional low ambient controls (optional wind baffle shall be required). The outdoor unit shall be able to operate with a maximum height difference of 100 feet (30 meters) between indoor and outdoor units.
  3. System shall have a maximum refrigerant tubing length of 100 feet for the 12,000 BTU/h units between indoor and outdoor units without the need for line size changes, traps or additional oil.
  4. Model PUY-A12NHA shall be pre-charged for a maximum of 70 feet (20 meters) of refrigerant tubing.
  5. The outdoor unit shall be completely factory assembled, piped, and wired. Each unit must be test run at the factory.
- C. Air-Cooled, Compressor-Condenser Components (AC-1/ACCU-1):
1. Cabinet: The casing shall be constructed from galvanized steel plate, coated with a finished with an electrostatically applied, thermally fused acrylic or polyester powder coating for corrosion protection and have a munsell 3Y 7.8/1.1 finish. The fan grill shall be of ABS plastic.
  2. Compressor:
    - a. The compressor for model PUY-A12NHA shall be a DC rotary compressor with Variable Compressor Speed Inverter Technology.
    - b. All compressors shall be driven by inverter circuit to control compressor speed. The compressor speed shall dynamically vary to match the zone space load for significantly increasing the efficiency of the system which results in vast energy savings. To prevent liquid from accumulating in the compressor during the off cycle, a minimal amount of current shall be intermittently applied to the compressor motor to maintain sufficient heat.



- c. The outdoor unit shall have an accumulator and high pressure safety switch. The compressor shall be mounted to avoid the transmission of vibration.
  - d. Refrigerant charge: R410A.
3. Fan:
- a. Model PUY-A12NHA shall be furnished with an AC fan motor.
  - b. The fan motor shall be of a aerodynamic design for quiet operation, and the fan motor bearings shall be permanently lubricated. The outdoor unit shall have horizontal discharge airflow. The fan shall be mounted in front of the coil, pulling air across it from the rear and dispelling it through the front. The fan shall be provided with a raised guard to prevent contact with moving parts.
4. Coil: The L shaped condenser coil shall be of copper tubing with flat aluminum fins to reduce debris build up. The coil shall be protected with an integral metal guard. Refrigerant flow from the condenser shall be controlled by means of linear expansion valve (LEV) metering orifice. The LEV shall be control by a microprocessor controlled step motor.
5. Electrical:
- a. The electrical power of the unit shall be 208 volts or 230 volts, 1 phase, 60 hertz. The unit shall be capable of satisfactory operation within voltage limits of 198 volts to 253 volts. The outdoor unit shall be controlled by the microprocessor located in the indoor unit.
  - b. The control signal between the indoor unit and the outdoor unit shall be pulse signal 24 volts DC. The unit shall have Pulse Amplitude Modulation circuit to utilize 98% of input power supply.
6. Low Ambient Kit: Permits operation down to 45 deg F.
7. Mounting Base: Polyethylene.

## 2.5 OUTDOOR UNITS (6 TONS OR MORE)

### A. Air-Cooled, Compressor-Condenser Components:

- 1. Casing: Steel, finished with baked enamel 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. 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 210/240.

3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
4. Fan: Aluminum-propeller type, directly connected to motor.
5. Motor: Permanently lubricated, with integral thermal-overload protection.
6. Mounting Base: Polyethylene.

## 2.6 ACCESSORIES

- A. Automatic-reset timer to prevent rapid cycling of compressor.
- B. 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.

## 2.7 CONTROL (AC-1/ACCU-1)

- A. The control system shall consist of two (2) microprocessors, one in each indoor and outdoor unit, interconnected by A-Control. This three (3) conductor 14 g a. AWG wire with ground method shall provide power feed and bi-directional digital control transmission between the outdoor and indoor units.
- B. The system shall be capable of automatic restart when power is restored after power interruption. The system shall have self-diagnostics ability, including total hours of compressor run time. Diagnostics codes for indoor and outdoor units shall be displayed on the wired controller display panel.
- C. The microprocessor located in the indoor unit shall have the capability of monitoring return air temperature and indoor coil temperature, receiving and processing commands from the wired controller, providing emergency operation and for controlling the operation of the outdoor unit.
- D. The indoor unit shall be connected to a wall mounted wired controller to perform input functions necessary to operate the system. The wired controller shall have a large multi-language DOT liquid crystal display (LCD) presenting contents in eight (8) different languages, including English, French, Chinese, German, Japanese, Spanish, Russian, and Italian.
- E. There shall be a built-in weekly timer with up to eight pattern settings per day. The controller shall consist of an On/Off button, Increase/Decrease Set Temperature buttons, a Cool / Dry / Fan mode selector, a Timer Menu button, a Timer On/Off button, Set Time buttons, a Fan Speed selector, a Vane Position selector, a Louver Swing button, a Test Run button, and a Check Mode button. The controller shall have a built-in temperature sensor. Temperature shall be displayed in either Fahrenheit (°F) or Celsius (°C). Temperature changes shall be by increments of 1°F (1°C) with a range of 67°F to 87°F (19°C to 30°C).
- F. The wired controller shall display operating conditions such as set temperature, room temperature, pipe temperatures ( i.e. liquid, discharge, indoor and outdoor), compressor operating conditions ( including running current, frequency, input voltage, On/Off status and operating time), LEV opening pulses, sub cooling and discharge super heat.
- G. Normal operation of the wired controller shall provide individual system control in which one wired controller and one indoor unit are installed in the same room. Temperature sensing shall be done by a Thermistor mounted in the return air stream of the indoor unit. An alternate

temperature sensor shall be located within the wall controller. Selection of the sensor is by switch in the indoor unit. The controller shall have the capability of controlling up to a maximum of sixteen systems at a maximum developed control cable distance of 1,650 feet (500 meters).

- H. The control voltage from the wired controller to the indoor unit shall be a digital +/-24 volts, DC signal. The control signal between the indoor and outdoor unit shall be pulse signal 24 volts DC. Up to two wired controllers shall be able to be used to control one unit.
- I. Control system shall control the continued operation of the air sweep louvers, as well as provide On/Off and mode switching. The controller shall have the capability to provide sequential starting with up to fifty seconds delay.
- J. A two wire (one pair) twisted, stranded, 18 gauge (AWG), jacketed, control cable shall be used to connect the controller to the indoor unit.

2.8 PERFORMANCE (AC-1/ACCU-1)

- A. Each system shall perform in accordance to the ratings shown in the table below. Cooling performance shall be based on 80°F DB, 67°F WB (26.7°C DB, 19.4°C WB) for the indoor unit and 95°F DB, 75°F WB (35°C DB, 29.3°C WB) for the outdoor unit.

System Model Number	Cooling Capacity Btu/h	TPW Cooling	SEER	CFM (Hi/Dry)
PLA-12BA	6,000 – 12,000	1,260	13.5	530

TPW = Total Power Watts

Operating Range		Indoor Air Intake Temperature	Outdoor Air Intake Temperature
Cooling	Maximum	D.B. 95°F (35°C) W.B. 71°F (21.7°C)	D.B. 115°F (46°C)
	Minimum	D.B. 67°F (19.4°C) W.B. 57°F (13.9°C)	D.B. 0°F (-18°C)*

\* Requires wind baffle – without wind baffle: D.B. 23°F (-5°C)

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install ground-mounted, compressor-condenser components on polyethylene mounting base.

- D. Install and connect precharged reaafrigerant 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. Duct Connections: Duct installation requirements are specified in Section 233113 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Section 233300 "Air Duct Accessories."

### 3.3 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. Perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.

### 3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 238126

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
  - 1. Electrical equipment coordination and installation.
  - 2. Sleeves for raceways and cables.
  - 3. Common electrical installation requirements.

1.3 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
  - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
  - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
  - 3. To allow right of way for piping and conduit installed at required slope.
  - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate sleeves election and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

### 3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- I. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- J. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

### 3.3 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 260500

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
  - 1. Building wires and cables rated 600 V and less.
  - 2. Connectors, splices, and terminations rated 600 V and less.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. American Insulated Wire Corp.; a Leviton Company.
  - 2. General Cable Corporation.
  - 3. Senator Wire & Cable Company.
  - 4. Southwire Company.
- B. Copper Conductors: Comply with NEMA WC 70.
- C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN and UL 854 for use-2.
- D. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC with ground wire.

2.2 CONNECTORS AND SPLICES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems, Inc.
2. Hubbell Power Systems, Inc.
3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M; Electrical Products Division.
5. Tyco Electronics Corp.

- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

## PART 3 - EXECUTION

### 3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

### 3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type SE or use-2, single conductors in raceway .
- B. Exposed Feeders: Type THHN-THWN, single conductors in raceway .
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-THWN, single conductors in raceway .
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- E. Exposed Branch Circuits: Type THHN-THWN, single conductors in raceway or Metal-clad cable, Type MC .
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway or Metal-clad cable, Type MC.
- G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- H. Class 1 Control Circuits: Type THHN-THWN, in raceway.
- I. Class 2 Control Circuits: Type THHN-THWN, in raceway .

### 3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.



- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."
- F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

### 3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

### 3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both wall surfaces.
- F. Extend sleeves installed in floors 2 inches above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and cable unless sleeve seal is to be installed.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials according to Division 07 Section "Penetration Firestopping."

- K. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between cable and sleeve for installing mechanical sleeve seals.

### 3.6 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground exterior-wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### 3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping."

### 3.8 FIELD QUALITY CONTROL

- A. Tests and Inspections:
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
  - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- B. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
  - 1. Solid Conductors: ASTM B 3.
  - 2. Stranded Conductors: ASTM B 8.
  - 3. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  - 4. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- C. Grounding Bus: Rectangular bars of annealed copper, as indicated on electrical drawings.

2.2 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
  - 1. Pipe Connectors: Clamp type, sized for pipe.

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- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

### 2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch diameter by 10 feet in diameter.

## PART 3 - EXECUTION

### 3.1 APPLICATIONS

- A. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- B. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
  - 1. Install bus on insulated spacers 1 inch, minimum, from wall 6 inches above finished floor, unless otherwise indicated.
- C. Conductor Terminations and Connections:
  - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  - 2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.
  - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
  - 4. Connections to Structural Steel: Welded connectors.

### 3.2 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Water Heater and Heat-Tracing, Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- C. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

### 3.3 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
  - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.

2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
  3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- D. Grounding and Bonding for Piping:
1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
  2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
  3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

### 3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
  2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.
    - a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    - b. Perform tests by fall-of-potential method according to IEEE 81.
- B. Report measured ground resistances that exceed the following values:
1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
  2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
- C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
  - 1. Hangers and supports for electrical equipment and systems.
  - 2. Construction requirements for concrete bases.
- B. Related Sections include the following:
  - 1. Division 26 Section "Vibration And Seismic Controls For Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 70.

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 Division 03.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Factory-fabricated components for field assembly.
  - 1. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
  - 2. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.

3. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
  1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
  2. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
  3. Toggle Bolts: All-steel springhead type.
  4. Hanger Rods: Threaded steel.

### PART 3 - EXECUTION

#### 3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
  1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.

#### 3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
  1. To New Concrete: Bolt to concrete inserts.
  2. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  3. To Existing Concrete: Expansion anchor fasteners.
  4. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.

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5. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

END OF SECTION 260529



SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Related Sections include the following:
  - 1. Division 26 Section " Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. FMC: Flexible metal conduit.
- C. IMC: Intermediate metal conduit.
- D. LFMC: Liquidtight flexible metal conduit.
- E. RNC: Rigid nonmetallic conduit.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. Rigid Steel Conduit: ANSI C80.1.
- B. IMC: ANSI C80.6.
- C. EMT: ANSI C80.3.

- D. FMC: Zinc-coated steel.
- E. LFMC: Flexible steel conduit with PVC jacket.
- F. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
  - 1. Fittings for EMT: Steel, set-screw type.

## 2.2 NONMETALLIC CONDUIT AND TUBING

- A. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.
- B. Fittings for RNC: NEMA TC 3; match to conduit or tubing type and material.

## 2.3 BOXES, ENCLOSURES, AND CABINETS

- A. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- C. Metal Floor Boxes: Cast or sheet metal, fully adjustable, rectangular.
- D. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

## PART 3 - EXECUTION

### 3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
  - 1. Exposed Conduit: Rigid steel conduit or IMC.
  - 2. Concealed Conduit, Aboveground: IMC.
  - 3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried.
  - 4. Connection to Vibrating Equipment (Including Transformers or Motor-Driven Equipment): LFMC.
  - 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Comply with the following indoor applications, unless otherwise indicated:
  - 1. Exposed, Not Subject to Physical Damage: EMT.
  - 2. Concealed in Ceilings and Interior Walls and Partitions: EMT.
  - 3. Connection to Vibrating Equipment (Including Transformers or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
  - 4. Damp or Wet Locations: IMC.
  - 5. Boxes and Enclosures: NEMA 250, Type 1.
- C. Minimum Raceway Size: 1/2-inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

### 3.2 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
- H. Raceways Embedded in Slabs:
  1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
  2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
  3. Change from RNC to rigid steel conduit, or IMC before rising above the floor.
- I. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- J. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.
- K. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for recessed and semirecessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
  1. Use LFMC in damp or wet locations subject to severe physical damage.
  2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- L. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.
- M. Set metal floor boxes level and flush with finished floor surface.

### 3.3 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Division 31 Section "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
  - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
  - b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

#### 3.4 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 260533

SECTION 260548 - VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:

1. Isolation pads.
2. Spring isolators.
3. Restrained spring isolators.
4. Channel support systems.
5. Restraint cables.
6. Hanger rod stiffeners.
7. Anchorage bushings and washers.

- B. Related Sections include the following:

1. Division 26 Section "Hangers And Supports For Electrical Systems" for commonly used electrical supports and installation requirements.

1.3 DEFINITIONS

- A. The IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: See structural drawings for class.
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: See structural drawings for seismic use group.
  - a. Component Importance Factor: As indicated on structural drawings.
  - b. Component Response Modification Factor: As indicated on structural drawings.
  - c. Component Amplification Factor: As indicated on structural drawings.
3. Design Spectral Response Acceleration at Short Periods (0.2 Second): As indicated on structural drawings.
4. Design Spectral Response Acceleration at 1.0-Second Period: As indicated on structural drawings.

## 1.5 SUBMITTALS

- A. Product Data: For the following:
1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
  2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
    - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
    - b. Annotate to indicate application of each product submitted and compliance with requirements.
  3. Restrained-Isolation Devices: Include ratings for horizontal, vertical, and combined loads.

## 1.6 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. 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 a nother agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.
- D. Comply with NFPA 70.

## PART 2 - PRODUCTS

### 2.1 VIBRATION ISOLATORS

- A. Pads: Arrange in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
1. Resilient Material: Oil- and water-resistant neoprene.
- B. Spring Isolators: Freestanding, laterally stable, open-spring isolators.
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
  6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
- C. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.
1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
  2. Restraint: Seismic or limit-stop as required for equipment and authorities having jurisdiction.
  3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

## 2.2 SEISMIC-RESTRAINT DEVICES

- A. General Requirements for Restraint Components: Rated strengths, features, and application requirements shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- B. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- C. Restraint Cables: ASTM A 492 stainless-steel cables with end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- D. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod. Do not weld stiffeners to rods.
- E. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchors and studs.
- F. 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.
- G. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

## 2.3 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
  - 1. Powder coating on springs and housings.
  - 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
  - 3. Baked enamel or powder coat for metal components on isolators for interior use.
  - 4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- 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 Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

### 3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Equipment and Hanger Restraints:
  - 1. Install restrained isolators on electrical equipment.
  - 2. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- C. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- D. Drilled-in Anchors:



1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

### 3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

### 3.5 ADJUSTING

- A. 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.
- B. Adjust active height of spring isolators.
- C. Adjust restraints to permit free movement of equipment within normal mode of operation.

### 3.6 ELECTRICAL VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE SCHEDULE

- A. Supported or Suspended Equipment:
  1. Pads:
    - a. Material: Neoprene.
    - b. Thickness: 1/4" minimum.
    - c. Durometer: 70.
    - d. Number of Pads: Two thick.
  2. Component Importance Factor: As indicated on structural drawings.
  3. Component Response Modification Factor: As indicated on structural drawings.
  4. Component Amplification Factor: As indicated on structural drawings.

END OF SECTION 260548

## SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Identification for conductors.
  - 2. Underground-line warning tape.
  - 3. Warning labels and signs.
  - 4. Equipment identification labels.
  - 5. Miscellaneous identification products.

#### 1.3 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- C. Comply with ANSI Z535.4 for safety signs and labels.

#### 1.4 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams and with those required by codes and standards. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

### PART 2 - PRODUCTS

#### 2.1 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

#### 2.2 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
2. Printing on tape shall be permanent and shall not be damaged by burial operations.
3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

2.3 WARNING LABELS AND SIGNS

A. Comply with NFPA 70.

- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

2.4 EQUIPMENT IDENTIFICATION LABELS

- A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.
- G. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

- A. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
  - a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
  - b. Colors for 208/120-V Circuits:
    - 1) Phase A: Black.
    - 2) Phase B: Red.
    - 3) Phase C: Blue.
  - c. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
  
- B. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels .
  1. Identify system voltage with black letters on an orange background.
  2. Apply to exterior of door, cover, or other access.
  
- C. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams and schedules. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
  1. Labeling Instructions:
    - a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.
    - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
    - c. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
  
  2. Equipment to Be Labeled:
    - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be engraved, laminated acrylic or melamine label.
    - b. Enclosures and electrical cabinets.
    - c. Enclosed switches.
    - d. Enclosed circuit breakers.
    - e. Contactors.

END OF SECTION 260553

## SECTION 260923 - LIGHTING CONTROL DEVICES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following lighting control devices:
  - 1. Outdoor photoelectric switches.
  - 2. Indoor occupancy sensors.
  - 3. Lighting contactors.
- B. Related Sections include the following:
  - 1. Division 26 Section "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

#### 1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. PIR: Passive infrared.

#### 1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

#### 1.5 COORDINATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

### PART 2 - PRODUCTS

#### 2.1 OUTDOOR PHOTOELECTRIC SWITCHES

- A. Description: Solid state, with SPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.

1. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of photocell to prevent fixed light sources from causing turn-off.
2. Time Delay: 15-second minimum, to prevent false operation.

## 2.2 INDOOR OCCUPANCY SENSORS

- A. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.
1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
  2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
  3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
  4. Mounting:
    - a. Sensor: Suitable for mounting in any position on a standard outlet box.
    - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
    - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
  5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
  6. Bypass Switch: Override the on function in case of sensor failure.
  7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; keep lighting off when selected lighting level is present.
- B. PIR Type: Ceiling mounting; detect occupancy by sensing a combination of heat and movement in area of coverage.
1. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in..
  2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.

## 2.3 LIGHTING CONTACTORS

- A. Description: Electrically operated and electrically held complying with NEMA ICS 2 and UL 508.
1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
  2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
  3. Enclosure: Comply with NEMA 250.

## 2.4 CONDUCTORS AND CABLES

NFCU

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### PART 3 - EXECUTION

#### 3.1 SENSOR INSTALLATION

- A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

#### 3.2 CONTACTOR INSTALLATION

- A. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

#### 3.3 WIRING INSTALLATION

- A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 1/2 inch.
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

#### 3.4 IDENTIFICATION

- A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."
  - 1. Identify controlled circuits in lighting contactors.
- B. Label time switches and contactors with a unique designation.

#### 3.5 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

END OF SECTION 260923

## SECTION 262416 - PANELBOARDS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Distribution panelboards.
  - 2. Lighting and appliance branch-circuit panelboards.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
  - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
  - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
  - 3. Detail bus configuration, current, and voltage ratings.
  - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
  - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

#### 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- 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.
- C. Comply with NEMA PB 1.
- D. Comply with NFPA 70.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Handle and prepare panelboards for installation according to NECA 407 and NEMA PB 1.



1.6 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
  - a. Altitude: Not exceeding 6600 feet (2000 m).

B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of electric service.

1.7 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Enclosures: Surface -mounted cabinets.

1. Rated for environmental conditions at installed location.
  - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
2. Finishes:
  - a. Panels and Trim: Steel , factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
  - b. Back Boxes: Galvanized steel.

3. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.

B. Incoming Mains Location: Top and bottom.

C. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
3. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.

D. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Main and Neutral Lugs: Mechanical type.
3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

## 2.2 DISTRIBUTION PANELBOARDS

A. Panelboards: NEMA PB 1, power and feeder distribution type. Fully Rated.

B. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches high, provide two latches, keyed alike.

C. Mains: As indicated on the drawings.

D. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

## 2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type. Fully Rated.

B. Mains: Circuit breaker or lugs only.

C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

D. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

## 2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
  - a. Standard frame sizes, trip ratings, and number of poles.
  - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
  - c. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NECA 407 and NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Install panelboards and accessories according to NECA 407 and NEMA PB 1.1.
- B. Mount top of trim 72 inches above finished floor unless otherwise indicated.
- C. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- D. Install filler plates in unused spaces.
- E. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.
- F. Comply with NECA 1.

#### 3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

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### 3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- C. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Panelboards will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### 3.5 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
  - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
  - 2. Twist-locking receptacles.
  - 3. Isolated-ground receptacles.
  - 4. Snap switches and wall-box dimmers.
  - 5. Floor service outlets.

1.3 DEFINITIONS

- A. GFCI: Ground-fault circuit interrupter.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
- 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 NFPA 70.

1.5 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

PART 2 - PRODUCTS

2.1 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

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- B. Isolated-Ground, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
  - 1. Description: Straight blade; equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.
- C. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
  - 1. Description: Labeled to comply with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.

## 2.2 TWIST-LOCKING RECEPTACLES

- A. Single Convenience Receptacles: Comply with NEMA WD 1, NEMA WD 6 and shall be as indicated on drawings..

## 2.3 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20.

## 2.4 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
  - 1. Plate-Securing Screws: Metal with head color to match plate finish.
  - 2. Material for Finished Spaces: Smooth, high-impact thermoplastic.
  - 3. Material for Unfinished Spaces: Smooth, high-impact thermoplastic.
  - 4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in "wet locations."
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant thermoplastic with lockable cover.

## 2.5 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
  - 1. Wiring Devices Connected to Normal Power System: Almond, unless otherwise indicated or required by NFPA 70 or device listing.
  - 2. Wiring Devices Connected to Emergency Power System: Red.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:

1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
  - a. Cut back and pigtail, or replace all damaged conductors.
  - b. Straighten conductors that remain and remove corrosion and foreign matter.
  - c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

### 3.2 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

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END OF SECTION 262726



SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
  - 1. Cartridge fuses rated 600-V ac and less for use in enclosed switches .

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
  - 1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
  - 2. Fuse sizes for elevator feeders and elevator disconnect switches.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.
- 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.
- C. Comply with NFPA 70.
- D. Comply with NEMA FU 1 for cartridge fuses.

1.5 PROJECT CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.6 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

1.7 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

PART 2 - PRODUCTS

2.1 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

- A. Cartridge Fuses:
  - 1. Motor Branch Circuits: Class RK5, time delay.

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.4 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

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END OF SECTION 262813

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
  - 1. Fusible switches.
  - 2. Nonfusible switches.
  - 3. Enclosures.

1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.

1.4 PERFORMANCE REQUIREMENTS

1.5 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
  - 1. Enclosure types and details for types other than NEMA 250, Type 1.
  - 2. Current and voltage ratings.
  - 3. Short-circuit current ratings.

1.6 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. Comply with NFPA 70.

1.7 COORDINATION

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- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

### 1.8 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
  - 2. Fuse Pullers: Two for each size and type.

## PART 2 - PRODUCTS

### 2.1 FUSIBLE SWITCHES

- A. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- B. Accessories:
  - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
  - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
  - 3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
  - 4. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
  - 5. Lugs: Mechanical type, suitable for number, size, and conductor material.
  - 6. Service-Rated Switches: Labeled for use as service equipment.

### 2.2 NONFUSIBLE SWITCHES

- A. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- B. Accessories:
  - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
  - 2. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
  - 3. Lugs: Mechanical type, suitable for number, size, and conductor material.

### 2.3 ENCLOSURES

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- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
  - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
  - 2. Outdoor Locations: NEMA 250, Type 3R.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- C. Comply with NECA 1.

#### 3.3 IDENTIFICATION

- A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."
  - 1. Label each enclosure with engraved metal or laminated-plastic nameplate.

#### 3.4 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 262816

SECTION 265100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Interior lighting fixtures, lamps, and ballasts.
2. Emergency lighting units.
3. Exit signs.
4. Lighting fixture supports.

B. Related Sections:

1. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
2. Division 26 Section "Wiring Devices" for manual wall-box dimmers for incandescent lamps.

1.3 DEFINITIONS

- A. BF: Ballast factor.
- B. CCT: Correlated color temperature.
- C. CRI: Color-rendering index.
- D. HID: High-intensity discharge.
- E. LER: Luminaire efficacy rating.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.4 SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
  1. Physical description of lighting fixture including dimensions.
  2. Ballast, including BF.
  3. Energy-efficiency data.
  4. Life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps.

5. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.
  - a. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

#### 1.5 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- 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.
- C. Comply with NFPA 70.

#### 1.6 COORDINATION

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

#### 1.7 WARRANTY

- A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
  1. Warranty Period for Emergency Fluorescent Ballast Batteries: Seven years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining six years.

#### 1.8 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
  2. Plastic Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
  3. Ballasts: One for every 100 of each type and rating installed. Furnish at least one of each type.



## 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, product(s) indicated on Drawings.

### 2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
- C. Metal Parts: Free of burrs and sharp corners and edges.
- D. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.
- E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- F. Diffusers and Globes:
  - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
    - a. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
    - b. UV stabilized.
- G. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
  - 1. Label shall include the following lamp and ballast characteristics:
    - a. "USE ONLY" and include specific lamp type.
    - b. Lamp diameter code (T-4, T-5, T-8, T-12, etc.), tube configuration (twin, quad, triple, etc.), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
    - c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
    - d. Start type (preheat, rapid start, instant start, etc.) for fluorescent and compact fluorescent luminaires.
    - e. ANSI ballast type (M98, M57, etc.) for HID luminaires.
    - f. CCT and CRI for all luminaires.

### 2.3 BALLASTS FOR LINEAR FLUORESCENT LAMPS

- A. General Requirements for Electronic Ballasts:

1. Comply with UL 935 and with ANSI C82.11.
2. Designed for type and quantity of lamps served.
3. Ballasts shall be designed for full light output unless another BF, dimmer, or bi-level control is indicated.
4. Sound Rating: Class A.
5. Total Harmonic Distortion Rating: Less than 10 percent.
6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
7. Operating Frequency: 42 kHz or higher.
8. Lamp Current Crest Factor: 1.7 or less.
9. BF: 0.88 or higher.
10. Power Factor: 0.95 or higher.
11. Parallel Lamp Circuits: Multiple lamp ballasts shall comply with ANSI C82.11 and shall be connected to maintain full light output on surviving lamps if one or more lamps fail.

B. Luminaires controlled by occupancy sensors shall have programmed-start ballasts.

C. Electronic Programmed-Start Ballasts: Comply with ANSI C82.11 and the following:

1. Lamp end-of-life detection and shutdown circuit for T5 diameter lamps.
2. Automatic lamp starting after lamp replacement.

D. Ballasts for Low-Temperature Environments:

1. Temperatures 0 Deg F and Higher: Electronic type rated for 0 deg F starting and operating temperature with indicated lamp types.

## 2.4 BALLASTS FOR COMPACT FLUORESCENT LAMPS

A. Description: Electronic-programmed rapid-start type, complying with UL 935 and with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:

1. Lamp end-of-life detection and shutdown circuit.
2. Automatic lamp starting after lamp replacement.
3. Sound Rating: Class A.
4. Total Harmonic Distortion Rating: Less than 20 percent.
5. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
6. Operating Frequency: 20 kHz or higher.
7. Lamp Current Crest Factor: 1.7 or less.
8. BF: 0.95 or higher unless otherwise indicated.
9. Power Factor: 0.95 or higher.

## 2.5 EMERGENCY FLUORESCENT POWER UNIT

A. Internal/External Type: Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture body and compatible with ballast. Comply with UL 924.

1. Emergency Connection: Operate one fluorescent lamp(s) continuously at an output of 2750 lumens each. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
2. Test Push Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.

- a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
  - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
3. Battery: Sealed, maintenance-free, nickel-cadmium type.
  4. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
  5. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

## 2.6 BALLASTS FOR HID LAMPS

- A. Electronic Ballast for Metal-Halide Lamps: Include the following features unless otherwise indicated:
  1. Minimum Starting Temperature: Minus 20 deg F for single-lamp ballasts.
  2. Rated Ambient Operating Temperature: 130 deg F.
  3. Lamp end-of-life detection and shutdown circuit.
  4. Sound Rating: Class A.
  5. Total Harmonic Distortion Rating: Less than 20 percent.
  6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
  7. Lamp Current Crest Factor: 1.5 or less.
  8. Power Factor: 0.90 or higher.
  9. Interference: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
  10. Protection: Class P thermal cutout.

## 2.7 EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
  1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
    - a. Battery: Sealed, maintenance-free, nickel-cadmium type.
    - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
    - c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
    - d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

## 2.8 FLUORESCENT LAMPS

- A. T8 rapid-start lamps, rated 32 W maximum, nominal length of 48 inches, 2800 initial lumens (minimum), CRI 75 (minimum), color temperature 4100 K, and average rated life 20,000 hours unless otherwise indicated.

- B. T8 rapid-start lamps, rated 17 W maximum, nominal length of 24 inches, 1300 initial lumens (minimum), CRI 75 (minimum), color temperature 4100 K, and average rated life of 20,000 hours unless otherwise indicated.
- C. Compact Fluorescent Lamps: 4-Pin, CRI 80 (minimum), color temperature 4100 K, average rated life of 10,000 hours at three hours operation per start unless otherwise indicated.
  - 1. 13 W: T4, double or triple tube, rated 900 initial lumens (minimum).
  - 2. 18 W: T4, double or triple tube, rated 1200 initial lumens (minimum).
  - 3. 26 W: T4, double or triple tube, rated 1800 initial lumens (minimum).
  - 4. 32 W: T4, triple tube, rated 2400 initial lumens (minimum).
  - 5. 42 W: T4, triple tube, rated 3200 initial lumens (minimum).

## 2.9 HID LAMPS

- A. Metal-Halide Lamps: ANSI C78.43, with minimum CRI 65, and color temperature 4000 K.

## 2.10 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.
- C. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Lighting fixtures:
  - 1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
  - 2. Install lamps in each luminaire.
- B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.
- C. Remote Mounting of Ballasts: Distance between the ballast and fixture shall not exceed that recommended by ballast manufacturer. Verify, with ballast manufacturers, maximum distance between ballast and luminaire.
- D. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.
  - 1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches from lighting fixture corners.
  - 2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.

3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

E. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
3. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.

F. Connect wiring according to Division 26 Section " Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

3.3 STARTUP SERVICE

- A. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner.

END OF SECTION 265100

SECTION 265600 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Exterior luminaires with lamps and ballasts.
- 2. Luminaire-mounted photoelectric relays.
- 3. Poles and accessories.

- B. Related Sections:

- 1. Division 26 Section "Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color-rendering index.
- C. HID: High-intensity discharge.
- D. LER: Luminaire efficacy rating.
- E. Luminaire: Complete lighting fixture, including ballast housing if provided.
- F. Pole: Luminaire support structure, including tower used for large area illumination.
- G. Standard: Same definition as "Pole" above.

1.4 SUBMITTALS

- A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:
  - 1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
  - 2. Details of attaching luminaires and accessories.
  - 3. Details of installation and construction.
  - 4. Luminaire materials.

5. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories.
    - a. Manufacturer Certified Data: Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
  6. Ballasts, including energy-efficiency data.
  7. Lamps, including life, output, CCT, CRI, lumens, and energy-efficiency data.
  8. Materials, dimensions, and finishes of poles.
  9. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
- B. Qualification Data: For qualified agencies providing photometric data for lighting fixtures.
- C. Field quality-control reports.

#### 1.5 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- 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.
- C. Comply with IEEE C2, "National Electrical Safety Code."
- D. Comply with NFPA 70.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store poles on decay-resistant-treated skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- B. Retain factory-applied pole wrappings on metal poles until right before pole installation.

#### 1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.
  1. Warranty Period for Luminaires: Five years from date of Substantial Completion.
  2. Warranty Period for Metal Corrosion: Five years from date of Substantial Completion.
  3. Warranty Period for Color Retention: Five years from date of Substantial Completion.
  4. Warranty Period for Poles: Repair or replace lighting poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than three years from date of Substantial Completion.

1.8 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Lamps: One for every 100 of each type and rating installed. Furnish at least one of each type.
  - 2. Glass and Plastic Lenses, Covers, and Other Optical Parts: One for every 100 of each type and rating installed. Furnish at least one of each type.
  - 3. Ballasts: One for every 100 of each type and rating installed. Furnish at least one of each type.
  - 4. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

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, product(s) indicated on Drawings.

2.2 GENERAL REQUIREMENTS FOR LUMINAIRES

- A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.
  - 1. LER Tests Fluorescent Fixtures: Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
  - 2. LER Tests HID Fixtures: Where LER is specified, test according to NEMA LE 5B.
- B. Lateral Light Distribution Patterns: Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- C. Metal Parts: Free of burrs and sharp corners and edges.
- D. Sheet Metal Components: Corrosion-resistant aluminum unless otherwise indicated. Form and support to prevent warping and sagging.
- E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.
- G. Exposed Hardware Material: Stainless steel.
- H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.



- J. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
  - 1. White Surfaces: 85 percent.
  - 2. Specular Surfaces: 83 percent.
  - 3. Diffusing Specular Surfaces: 75 percent.
- K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- L. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.
- M. Color: As indicated in the lighting fixture schedule on drawings.
- N. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
  - 1. Label shall include the following lamp and ballast characteristics:
    - a. "USES ONLY" and include specific lamp type.
    - b. Lamp diameter code (T-4, T-5, T-8, T-12), tube configuration (twin, quad, triple), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
    - c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
    - d. Start type (preheat, rapid start, instant start) for fluorescent and compact fluorescent luminaires.
    - e. ANSI ballast type (M98, M57, etc.) for HID luminaires.
    - f. CCT and CRI for all luminaires.

### 2.3 FLUORESCENT BALLASTS AND LAMPS

- A. Ballasts for Low-Temperature Environments:
  - 1. Temperatures 0 Deg F and Higher: Electronic type rated for 0 deg F starting and operating temperature with indicated lamp types.
  - 2. Temperatures Minus 20 Deg F and Higher: Electromagnetic type designed for use with indicated lamp types.
- B. Ballast Characteristics:
  - 1. Power Factor: 90 percent, minimum.
  - 2. Sound Rating: Class A.
  - 3. Total Harmonic Distortion Rating: Less than 10 percent.
  - 4. Electromagnetic Ballasts: Comply with ANSI C82.1, energy-saving, high power factor, Class P, automatic-reset thermal protection.
  - 5. Case Temperature for Compact Lamp Ballasts: 65 deg C, maximum.
  - 6. Transient-Voltage Protection: Comply with IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
- C. Low-Temperature Lamp Capability: Rated for reliable starting and operation with ballast provided at temperatures 0 deg F and higher.

## 2.4 BALLASTS FOR HID LAMPS

- A. Comply with ANSI C82.4 and UL 1029 and capable of open-circuit operation without reduction of average lamp life. Include the following features unless otherwise indicated:
  - 1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.
  - 2. Minimum Starting Temperature: Minus 22 deg F.
  - 3. Normal Ambient Operating Temperature: 104 deg F.

## 2.5 HID LAMPS

- A. Metal-Halide Lamps: ANSI C78.43, with minimum CRI 65, and CCT color temperature 4000 K.

## 2.6 GENERAL REQUIREMENTS FOR POLES AND SUPPORT COMPONENTS

- A. Structural Characteristics: Comply with AASHTO LTS-4-M.
  - 1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in "Structural Analysis Criteria for Pole Selection" Article.
  - 2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.
- B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.
- C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
  - 1. Materials: Shall not cause galvanic action at contact points.
  - 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.
  - 3. Anchor-Bolt Template: Plywood or steel.

## 2.7 STEEL POLES

- A. Poles: Comply with ASTM A 500, Grade B, carbon steel with a minimum yield of 46,000 psig; one-piece construction up to 40 feet in height with access handhole in pole wall.
  - 1. Shape: Square, straight.
  - 2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
- B. Brackets for Luminaires: Detachable, cantilever, without underbrace.
  - 1. Adapter fitting welded to pole, allowing the bracket to be bolted to the pole mounted adapter, then bolted together with stainless-steel bolts.
  - 2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire.
  - 3. Match pole material and finish.
- C. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

- D. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.
- E. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported cable times a 5.0 safety factor.
- F. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
  - 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or with SSPC-SP 8, "Pickling."
  - 2. Interior Surfaces of Pole: One coat of bituminous paint, or otherwise treat for equal corrosion protection.
  - 3. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
    - a. Color: As indicated on drawings.

### PART 3 - EXECUTION

#### 3.1 LUMINAIRE INSTALLATION

- A. Install lamps in each luminaire.
- B. Fasten luminaire to indicated structural supports.
- C. Adjust luminaires that require field adjustment or aiming.

#### 3.2 POLE INSTALLATION

- A. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.
- B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features unless otherwise indicated on Drawings:
  - 1. Fire Hydrants and Storm Drainage Piping: 60 inches.
  - 2. Water, Gas, Electric, Communication, and Sewer Lines: 10 feet.
  - 3. Trees: 15 feet from tree trunk.
- C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- D. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.

1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
2. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
3. Install base covers unless otherwise indicated.
4. Use a short piece of 1/2-inch- diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

E. Raise and set poles using web fabric slings (not chain or cable).

### 3.3 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Division 26 Section "Raceway and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

### 3.4 GROUNDING

- A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."
  1. Install grounding electrode for each pole unless otherwise indicated.
  2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

### 3.5 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.
  1. Verify operation of photoelectric controls.

END OF SECTION 265600

SECTION 283111 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
  - 1. Fire-alarm control unit.
  - 2. Manual fire-alarm boxes.
  - 3. System smoke detectors.
  - 4. Notification appliances.
  - 5. Addressable interface device.
  - 6. Digital alarm communicator transmitter.

1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. NICET: National Institute for Certification in Engineering Technologies.

1.4 SYSTEM DESCRIPTION

- A. Noncoded, addressable system, with multiplexed signal transmission, dedicated to fire-alarm service only.

1.5 SUBMITTALS

- A. General Submittal Requirements:
  - 1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect/Engineer.
  - 2. Shop Drawings shall be prepared by persons with the following qualifications:
    - a. Trained and certified by manufacturer in fire-alarm system design.
    - b. NICET-certified fire-alarm technician, Level III minimum.
    - c. Licensed or certified by authorities having jurisdiction.
- B. Product Data: For each type of product indicated.
- C. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.

1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
2. Include voltage drop calculations for notification appliance circuits.
3. Include battery-size calculations.
4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
5. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
6. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.

D. Qualification Data: For qualified Installer.

E. Field quality-control reports.

F. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," deliver copies to authorities having jurisdiction and include the following:

1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
3. Record copy of site-specific software.
4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
  - a. Frequency of testing of installed components.
  - b. Frequency of inspection of installed components.
  - c. Requirements and recommendations related to results of maintenance.
  - d. Manufacturer's user training manuals.
5. Manufacturer's required maintenance related to system warranty requirements.
6. Abbreviated operating instructions for mounting at fire-alarm control unit.
7. Copy of NFPA 25.

G. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

## 1.6 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

- B. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system.
- 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.
- D. NFPA Certification: Obtain certification according to NFPA 72 by an NRTL.

#### 1.7 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning with Substantial Completion, provide software support for two years.
- C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
  - 1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

#### 1.8 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
  - 2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
  - 3. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than 1 unit of each type.
  - 4. Detector Bases: Quantity equal to 10 percent of amount of each type installed, but no fewer than 1 unit of each type.
  - 5. Keys and Tools: One extra set for access to locked and tamperproofed components.
  - 6. Audible and Visual Notification Appliances: One of each type installed.
  - 7. Fuses: Two of each type installed in the system.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
  - 1. NOTIFIER; a Honeywell company.
  - 2. Siemens Building Technologies, Inc.; Fire Safety Division.
  - 3. Silent Knight; a Honeywell company.
  - 4. SimplexGrinnell LP; a Tyco International company.

5. EST, Edwards System Technology – GE Security

## 2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
  1. Duct smoke detectors.
  2. Automatic sprinkler system water flow.
- B. Fire-alarm signal shall initiate the following actions:
  1. Continuously operate alarm notification appliances.
  2. Transmit an alarm signal to the remote alarm receiving station.
  3. Record events in the system memory.
- C. Supervisory signal initiation shall be by one or more of the following devices and actions:
  1. Valve supervisory switch.
- D. System trouble signal initiation shall be by one or more of the following devices and actions:
  1. Open circuits, shorts, and grounds in designated circuits.
  2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
  3. Loss of primary power at fire-alarm control unit.
  4. Ground or a single break in fire-alarm control unit internal circuits.
  5. Abnormal ac voltage at fire-alarm control unit.
  6. Break in standby battery circuitry.
  7. Failure of battery charging.
  8. Abnormal position of any switch at fire-alarm control unit or annunciator.
- E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit.

## 2.3 FIRE-ALARM CONTROL UNIT

- A. General Requirements for Fire-Alarm Control Unit:
  1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.
    - a. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
    - b. Include a real-time clock for time annotation of events on the event recorder and printer.
- B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
  1. Annunciator and Display: Liquid-crystal type, 2 line(s) of 40 characters, minimum.
  2. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.



C. Circuits:

1. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class B.

- a. Initiating Device Circuits: Style B.
- b. Notification Appliance Circuits: Style Y.
- c. Signaling Line Circuits: Style 4.
- d. Install no more than 50 addressable devices on each signaling line circuit. Provide isolating module every 50 devices.

D. Notification Appliance Circuit: Operation shall sound in a temporal pattern.

E. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.

1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

F. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

1. Batteries: Sealed, valve-regulated, recombinant lead acid.

G. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.4 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

- 1. Comply with UL 268; operating at 24-V dc, nominal.
- 2. Detectors shall be two-wire type.
- 3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
- 4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
- 5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
- 6. Integral Visual-Indicating Light: LED type indicates detector has operated.
- 7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
  - a. Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F per minute.
  - b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F.
  - c. Provide multiple levels of detection sensitivity for each sensor.

B. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
  - a. Primary status.
  - b. Device type.
  - c. Present average value.
  - d. Present sensitivity selected.
  - e. Sensor range (normal, dirty, etc.).
3. Each sensor shall have multiple levels of detection sensitivity.
4. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
5. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

## 2.5 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.
  1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.
- B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol.
- C. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch-high letters on the lens.
  1. Rated Light Output:
    - a. 15/30/75/110 cd, selectable in the field.
  2. Mounting: Wall mounted unless otherwise indicated.
  3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
  4. Flashing shall be in a temporal pattern, synchronized with other units.
  5. Strobe Leads: Factory connected to screw terminals.
  6. Mounting Faceplate: Factory finished, red.

## 2.6 ADDRESSABLE INTERFACE DEVICE

- A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.

## 2.7 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.

- B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.
- C. Local functions and display at the digital alarm communicator transmitter shall include the following:
  - 1. Verification that both telephone lines are available.
  - 2. Programming device.
  - 3. LED display.
  - 4. Manual test report function and manual transmission clear indication.
  - 5. Communications failure with the central station or fire-alarm control unit.
- D. Digital data transmission shall include the following:
  - 1. Address of the alarm-initiating device.
  - 2. Zone of the supervisory signal.
  - 3. Zone of the trouble-initiating device.
  - 4. Loss of ac supply or loss of power.
  - 5. Low battery.
  - 6. Abnormal test signal.
  - 7. Communication bus failure.
- E. Secondary Power: Integral rechargeable battery and automatic charger.
- F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

### PART 3 - EXECUTION

#### 3.1 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72 for installation of fire-alarm equipment.
- B. Install wall-mounted equipment, with tops of cabinets not more than 72 inches above the finished floor.
- C. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.
- D. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.
- E. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.
- F. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling.
- G. Device Location-Indicating Lights: Locate in public space near the device they monitor.

- H. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches above the finished floor.

### 3.2 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 08 Section "Door Hardware." Connect hardware and devices to fire-alarm system.
  - 1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.
- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
  - 1. Supervisory connections at valve supervisory switches.
  - 2. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
  - 3. Supervisory connections at elevator shunt trip breaker.

### 3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- B. Install framed instructions in a location visible from fire-alarm control unit.
- C. Paint power-supply disconnect switch red and label "FIRE ALARM."

### 3.4 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

### 3.5 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by authorities having jurisdiction.
- 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. Visual Inspection: Conduct visual inspection prior to testing.
    - a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.

- b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
  3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
  4. Test visible appliances for the public operating mode according to manufacturer's written instructions.
  5. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
- D. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
  - E. Fire-alarm system will be considered defective if it does not pass tests and inspections.
  - F. Prepare test and inspection reports.

END OF SECTION 283111

## SECTION 311100 - CLEARING AND GRUBBING

### PART 1 - GENERAL

#### 1.1 SCOPE OF WORK

- A. The Contractor shall provide all labor, equipment and materials necessary to clear and grub the site to the limits indicated on the Drawings.
- B. The Contractor shall protect all existing structures, trees, or vegetation indicated on the Drawings to remain.
- C. The Contractor is solely responsible for determining the potential for injury to persons and damage to property. Where such potential is present, the contractor shall take appropriate measures to protect persons from injury and protect existing and new improvements from damage caused directly or indirectly by construction operations.

#### 1.2 RELATED DOCUMENTS

- A. Refer to the Civil Drawings issued by the Engineer for the specific project site.

#### 1.3 QUALITY ASSURANCE

- A. Obtain required permits and licenses in accordance with requirements of the Federal Clean Water Act (CWA), Water Quality Act (WQA), State laws, and Local laws.
- B. Provide temporary erosion control systems as indicated on the Drawings or as directed by the, Engineer, or Inspector to protect adjacent properties and water resources from erosion and sedimentation.
- C. Conduct operations and removal of debris with minimum interference to roads, streets, walks, and other adjacent facilities. Do not close or obstruct streets, walks or other facilities without permission from the authorities having jurisdiction.

#### 1.4 DEFINITIONS

- A. Clearing - Clearing shall consist of the felling, trimming, and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation designated for removal, including down timber, snags, brush, and rubbish occurring in the areas to be cleared.
- B. Grubbing - Grubbing shall consist of the removal and disposal of stumps, roots larger than 1/2 inch in diameter, and matted roots within the limits of work indicated on the plans.

### PART 2 - PRODUCTS

Not Applicable

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.
  - 1. Locate existing utilities as specified in elsewhere in Division 2.
  - 2. Verify that survey benchmark and intended elevations for the Work are as indicated and are not located in an area where they may be damaged.
  - 3. Verify that existing plant life and clearing limits are clearly tagged, identified and marked in such a manner as to insure their safety throughout construction operations.
- B. Report in writing to the Owner's Representative any prevailing conditions that will adversely affect satisfactory execution of the Work of this Section. Do not proceed with Work until unsatisfactory conditions have been corrected.
- C. By beginning Work, the Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to NFCU.

#### **3.2 PREPARATION**

- A. Provide temporary erosion control systems as indicated on the Drawings or as directed by the Engineer or Inspector to protect project site and adjacent properties and water resources from erosion and sedimentation.

#### **3.3 CLEARING**

- A. Trees, stumps, roots, brush, and other vegetation in areas to be cleared shall be cut off flush with or below the original ground surface, except such trees and vegetation as may be indicated or directed to be left standing.
- B. Trees designated to be left standing within the cleared areas shall be trimmed of dead branches 1-1/2 inches or more in diameter and shall be trimmed of all branches the heights indicated or directed. Limbs and branches to be trimmed shall be neatly cut close to the bole of the tree or main branches. Cuts more than 1-1/2 inches in diameter shall be painted with an approved tree-wound paint.
- C. Trees and vegetation to be left standing shall be protected from damage incident to clearing, grubbing, and construction operations by the erection of barriers or by such other means as the circumstances require.
- D. Clearing shall also include the removal and disposal of structures that obtrude, encroach upon, or otherwise obstruct the Work.

#### **3.4 GRUBBING**

- A. Material to be grubbed, together with logs and other organic or metallic debris not suitable for foundation purposes, shall be removed to a depth of not less than 18 inches below the original surface level of the ground in areas indicated to be grubbed and in areas indicated as construction areas under this contract, such as areas for buildings, and areas to be paved.
- B. Depressions made by grubbing shall be filled with suitable material and compacted to make the surface conform to the original adjacent surface of the ground.

### 3.5 TOPSOIL EXCAVATION

- A. Strip topsoil from areas that are indicated to be filled, excavated, landscaped, or re-graded to a depth that prevents contact with underlying subsoil or unsuitable material. Where trees are indicated to remain, stop topsoil stripping at a sufficient distance from tree to prevent damage to main root system.
- B. Cut heavy growths of grass from areas prior to start of stripping. Remove heavy growths of grass along with clearing of other vegetation materials.
- C. If the Contractor feels that storage on site will interfere with construction operations, he may elect to haul topsoil off site, protect and haul topsoil back again when needed for topsoiling, all at no additional expense to NFCU.
- D. Construct stockpile areas to positively drain surface water.
- E. Cover stockpile areas as required to prevent windblown dust.
- F. Dispose of unsuitable topsoil off-site as specified, unless directed otherwise by the Owner's Representative.
- G. Protect stockpiled topsoil from wetting, erosion and sedimenting by means of tarpaulins and by a perimeter barrier of boards staked in place, or other methods necessary.
- H. Topsoil stripped and stockpiled in quantities in excess of needs for new topsoiling shall be either stored or disposed of as directed by the Owner's Representative; obtain Owner's Representative decision.

### 3.6 TREE REMOVAL

- A. Where indicated or directed, trees and stumps that are designated as trees shall be removed from areas outside those areas designated for clearing and grubbing. This work shall include the felling of such trees and the removal of their stumps and roots as specified in section 3.4. Trees shall be disposed of as specified in section 3.7.

### 3.7 DISPOSAL OF MATERIALS

- A. All cleared material shall become the property of the Contractor and shall be hauled off site immediately and disposed of legally after obtaining necessary permits.
- B. Do not burn cleared material on site unless pit burning permits or other necessary permits, have been obtained by the Contractor through all relative governmental agencies.

### 3.8 TREE PROTECTION

- A. Tree protection shall be as shown on the Landscape Plans or as directed by the Owner's Representative or Arborist.

### 3.9 REPAIRS FOR DAMAGED TREES:

- A. Damaged trees to remain shall be repaired or replaced as directed by the Owner's Representative or Arborist.



**End of Section 311100**

**SECTION 312300 - EXCAVATION, FILLING, AND BACKFILLING FOR BUILDINGS AND UTILITY SYSTEMS**

**PART 1 - GENERAL**

1.1 SCOPE OF WORK

- A. The Contractor shall provide all labor, materials, equipment and incidentals necessary for excavating, filling, and backfilling for buildings and utility systems in conformance with the drawings and specifications, to include the recommendations provided in the geotechnical report by URS entitled Report, Foundation Investigation, Proposed Banking Facility, Westworth Village, Tarrant County, Texas, June 2008, Revised December 2011, URS File No. 15252306.
- B. The Contractor shall provide barricades, warning signs, and warning lights around open excavations as necessary to prevent injury to persons.
- C. The Contractor is solely responsible for determining the potential for injury to persons and damage to property. Where such potential is present, the contractor shall take appropriate measures to protect persons from injury and protect existing and new improvements from damage caused directly or indirectly by construction operations.

1.2 REFERENCE DOCUMENTS

- A. City of Westworth Village, Texas Standard Specifications
- B.
- C. Report, Foundation Investigation, Proposed Banking Facility, Westworth Village, Tarrant County, Texas, June 2008, Revised December 2011, URS File No. 15252306
- B. American Society for Testing and Materials
  - 1. ASTM D422 1963(2007) Standard Test Method for Particle-Size Analysis of Soils
  - 2. ASTM D698 2007e1 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft.)
  - 3. ASTM D1556 2007 Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
  - 4. ASTM D1557 2007 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft.)
  - 5. ASTM D2167 2008 Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
  - 6. ASTM D2216 2005 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil, and Rock by Mass
  - 7. ASTM D2487 2006 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
  - 8. ASTM D6938 2008 Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
  - 9. ASTM D2937 2004 Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method
  - 10. ASTM D3017 2005 Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
  - 11. ASTM D4318 2005 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

### 1.3 SUBMITTALS

Comply with the applicable provisions of Section 013400 Site Work Submittals.

- A. Test Reports: Testing laboratory will submit, within 24 hours of the completion of the test, the following reports directly to Navy Federal Credit Union (NFCU) and shall copy the Contractor:
  - 1. Analysis of fill and backfill materials.
  - 2. In-place density test reports.
  - 3. Moisture-density relationship test reports.
- B. Material Source: Submit name of imported materials suppliers. Provide materials from same source throughout the Work. Change of source requires NFCU approval.

### 1.4 QUALITY ASSURANCE

- A. Testing Laboratory Services: NFCU will secure and pay for the services of a Geotechnical Engineer to classify existing soil materials, to recommend and to classify proposed borrow materials when necessary, to verify compliance of materials with specified requirements, and to perform required field and laboratory testing.
- B. Coordinate and schedule in a timely manner with the Testing Agency the following quality control items:
  - 1. Perform the required tests per section 3.31.
  - 2. Verify quantities of material removed and quantities of material placed where Unit Prices are involved.

### 1.5 SITE CONDITIONS

- A. Traffic: Do not interfere with or close public ways without the permission of the governing authorities.
- B. Existing Site Utilities:
  - 1. Advise utility companies of excavation activities before starting excavations. Contractor shall enlist the services of a locating company to locate and identify all underground utilities passing through work area before starting work.
  - 2. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult NFCU immediately for directions. Cooperate with NFCU and/or utility companies in keeping respective services and facilities in operation.
  - 3. Protect existing utilities indicated to remain.
  - 4. Do not interrupt existing utilities without advance notice to and written approval from NFCU.
  - 5. Repair damaged utilities to satisfaction of utility company, at no additional cost to NFCU.
  - 6. Demolish and completely remove from the site all existing underground utilities indicated on the Drawings to be removed. Coordinate with utility companies for shut-off of services if lines are active.

### 1.6 PAYMENT

- A. Earth Excavation: Removal, reuse, and disposal of earth and other naturally occurring or man-made materials encountered other than materials classified as rock or unnecessary excavation. The cost of earth excavation shall be included in the cost of general construction.

- B. Rock Excavation: Excavation and disposal of rock material occurring as boulders or in beds, ledges, unstratified masses, and conglomerate deposits and which cannot be removed by the excavating equipment referenced below without the aid of systematic drilling and blasting. Drilling or blasting in order to increase productivity will not be cause for classification of materials as rock excavation.
1. General Excavation: A single-tooth ripper drawn by a crawler tractor having a draw bar pull rated at not less than 56,000 pounds (Caterpillar D-8K or equivalent) or a front-end loader with a minimum bucket breakout force of 25,600 pounds (Caterpillar 977 or equivalent).
  2. Trench Excavation: A backhoe having a bucket curling force rated at not less than 33,000 pounds (Caterpillar 225B or equivalent).
  3. Drilled Excavation: Use a rock auger if an earth auger hits refusal. When rock auger fails to advance 12" in 30 minutes the material will be classified as rock.
  4. Measurement: Perform rock excavation only after material has been cross-sectioned and classified, and after approval has been obtained.
  5. Measurement of rock excavation shall be the volume actually removed but shall in no case exceed the following:
    - a. Two feet outside of concrete forms other than at footings.
    - b. One foot outside of concrete forms for footings.
    - c. Six inches outside of required minimum dimensions of concrete cast against grade.
    - d. Required subgrade elevation beneath concrete slabs on grade, and allowing for capillary water barrier, where required or as directed by testing agency.
  6. Payment: Rock excavation will be paid on the basis of unit prices included in the contract documents. The unit price paid for rock excavation includes its replacement with approved materials.
- C. Select Granular Material
1. Select granular material shall be measured in place as the actual cubic yards replacing wet or unstable material in trench bottoms in authorized overdepth areas.
  2. The unit price shall include furnishing and placing the granular material, excavation and disposal of unsatisfactory material, and additional requirements for sheeting and bracing, pumping, bailing, cleaning, and other incidentals necessary to complete the work.
  3. Payment for select granular material will be made in addition to the bid price for trench excavation.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Satisfactory Materials: Satisfactory materials shall be as defined by the Geotechnical Engineer in accordance with ASTM D2487, and shall be materials compatible with the naturally occurring soils and conforming to the recommendations of the geotechnical report
- B. Unsatisfactory Materials: Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills, trash, refuse, or backfills from previous construction. Unsatisfactory material also includes material classified as satisfactory that contains root and other organic matter, frozen material, and stones larger than 3 inches. NFCU shall be notified of any contaminated materials.
- C. Cohesionless and Cohesive Materials: Cohesionless and cohesive materials shall be as defined by the Geotechnical Engineer in accordance with ASTM D2487.
- D. Expansive Soils: Soils judged expansive by the Geotechnical Engineer shall be tested as necessary to

determine if the soils are expansive, employing laboratory testing to determine an Expansion Index (EI, after ASTM D4829) greater than 20 or plasticity testing and particle size testing in accordance with ASTM D4318/ASTM D422.

- E. Nonfrost Susceptible Material: Nonfrost susceptible material shall be a uniformly graded, washed sand as defined by the Geotechnical Engineer.
- F. Unyielding Material: Unyielding material shall consist of rock and gravelly soils with stones greater than 3 inches in any dimension or as defined by the pipe manufacturer, whichever is smaller.
- G. Unstable Material: Unstable material shall consist of materials too wet to properly support the utility pipe, conduit, or appurtenant structure.
- H. Select Granular Material: Select granular material shall consist of well-graded sand, gravel, crushed gravel, or crushed stone composed of hard, tough and durable particles, and shall contain no more than 10 percent by weight of material passing a No. 200 mesh sieve and no less than 95 percent by weight passing the 1 inch sieve. The maximum allowable aggregate size shall be 1-1/2 inches, or the maximum size recommended by the pipe manufacturer, whichever is smaller.
- I. Initial Backfill Material Over Pipes: Initial backfill shall consist of select granular material or satisfactory materials free from rocks 2 inches or larger in any dimension or free from rocks of such size as recommended by the pipe manufacturer, whichever is smaller. When the pipe is coated or wrapped for corrosion protection, the initial backfill material shall be free of stones larger than 1 inch in any dimension or as recommended by the pipe manufacturer, whichever is smaller.

## 2.2 CAPILLARY WATER BARRIER

- A. Capillary Water Barrier shall consist of clean, crushed, nonporous rock, crushed gravel, or uncrushed gravel. The maximum particle size shall be 1-1/2 inches and no more than 2 percent by weight shall pass the No. 4 size sieve.

## 2.3 PLASTIC MARKING TAPE

- A. Plastic marking tape shall be acid and alkali-resistant polyethylene film, 6 inches wide with a minimum thickness of 0.004 inches.
- B. Tape shall have a minimum strength of 1750 psi lengthwise and 1500 psi crosswise.
- C. The tape shall be manufactured with integral wires, foil backing or other means to enable detection by a metal detector when the tape is buried up to 3 feet deep. The metallic core of the tape shall be encased in a protective jacket or provided with other means to protect it from corrosion.
- D. The tape shall be of a type specifically manufactured for marking and locating underground utilities.
- E. Tape color shall be as specified below and shall bear a continuous printed inscription that describes the specific utility.
  - 1. Red: Electric
  - 2. Yellow: Gas, Oil, Dangerous Materials
  - 3. Orange: Telephone, Telecommunications, Television
  - 4. Blue: Water Systems
  - 5. Green: Sewer Systems

### **PART 3 - EXECUTION**

#### **3.1 CLEARING AND GRUBBING**

- A. Clearing and grubbing is specified in Section 31 11 00 CLEARING AND GRUBBING.

#### **3.2 TOPSOIL**

- A. Topsoil shall be stripped to a depth below existing grade as recommended by the Geotechnical Engineer within the designated excavations and grading lines and deposited in storage piles for later use. Excess topsoil shall be disposed as specified for excess excavated material.

#### **3.3 EXCAVATION**

- A. Earth excavation shall be in conformance with the requirements of the geotechnical report and include removal and disposal of material not classified as rock excavation.
- B. Rock excavation shall include removal and disposition of material defined as rock in section 1.6.
- D. Excavation shall conform to the dimensions and elevations indicated for each building, structure and footing except as specified, and shall include trenching for utility and foundation drainage systems to a point 5 feet beyond the building line of each building and structure, excavation for outside grease interceptors, and all incidental work thereof.
- D. During excavation, material satisfactory for backfilling shall be stockpiled in an orderly manner at a distance from the banks of the trench equal to 1/2 the depth of the excavation, but in no instance closer than 2 feet.
- E. Excavation shall extend a sufficient distance from walls and footings to allow for placing and removal of forms.
- F. Excavations below indicated depths will not be permitted except to remove unsatisfactory material. Unsatisfactory material encountered below the grades shown shall be removed and replaced with satisfactory material.
- G. Satisfactory material removed below the depths indicated, without specific direction of NFCU, shall be replaced, at no additional cost to NFCU, with satisfactory materials to the indicated excavation grade; except that concrete footings shall be increased in thickness to the bottom of the overdepth excavations and over-break in rock excavation.
- H. Satisfactory material shall be placed and compacted as specified in section 3.21.
- I. Determination of elevations and measurements of approved overdepth excavation of unsatisfactory material below grades indicated shall be done under the direction of NFCU.
- J. Excavated material not required or not satisfactory for backfill shall be disposed of by direction of the Geotechnical Engineer.

#### **3.4 TRENCH EXCAVATION**

- A. The trench shall be excavated as recommended by the manufacturer of the pipe to be installed. Trench walls below the top of the pipe shall be sloped, or made vertical, and of such width as recommended in the manufacturer's installation manual. Where no manufacturer's installation manual is available, trench walls

shall be made vertical.

- B. Trench walls more than three (3) feet high shall be shored, cut back to a stable slope, or provided with equivalent means of protection for employees who may be exposed to moving ground or cave in.
- C. Trench walls which are cut back shall be excavated to at least the angle of repose of the soil. Special attention shall be given to slopes which may be adversely affected by weather or moisture content.
- D. The trench width below the top of pipe shall not exceed 24 inches plus pipe outside diameter (O.D.) for pipes of less than 24 inches inside diameter and shall not exceed 36 inches plus pipe outside diameter for sizes larger than 24 inches inside diameter.
- E. Where recommended trench widths are exceeded, the Contractor shall utilize redesign, stronger pipe, or special installation procedures. The cost of redesign, stronger pipe, or special installation procedures shall be borne by the Contractor without any additional cost to NFCU.

### 3.5 DRAINAGE

- A. Surface water shall be directed away from excavation and construction sites to prevent erosion and undermining of foundations.
- B. Diversion ditches, dikes and grading shall be provided and maintained as necessary during construction.
- C. Excavated slopes and backfill surfaces shall be protected to prevent erosion and sloughing.
- D. Excavation shall be performed so that the site, the area immediately surrounding the site, and the area affecting operations at the site shall be continually and effectively drained.

### 3.6 DEWATERING

- A. Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction.
- B. French drains, sumps, ditches or trenches will not be permitted within 3 feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made.
- C. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in situ material.
- D. While the excavation is open, the water level shall be maintained continuously, at a depth below the working level as determined by the Geotechnical Engineer.

### 3.7 SHORING

- A. Shoring, including sheet piling, shall be furnished and installed as necessary to protect workmen, banks, adjacent paving, structures, and utilities.
- B. Shoring, bracing, and sheeting shall be removed as excavations are backfilled, in a manner to prevent

caving.

- C. All shoring, bracing, and sheeting shall meet the requirements of the Occupational Safety & Health Administration and state and local laws as applicable.

### 3.8 CLASSIFICATION OF EXCAVATION

- A. Common excavation shall consist of all excavation not classified as rock excavation.
- B. Rock excavation shall be as defined in section 1.6.

### 3.9 BLASTING

- A. Blasting will not be permitted.

### 3.10 BORROW

- A. Where satisfactory materials are not available in sufficient quantity from required excavations, approved materials shall be obtained from approved sources off site without additional charge to NFCU.

### 3.11 EXCAVATED MATERIALS

- A. Satisfactory excavated material required for fill or backfill shall be placed in the proper section of the permanent work required under this section or shall be separately stockpiled if it cannot be readily placed.
- B. Satisfactory material in excess of that required for the permanent work and all unsatisfactory material shall be disposed of at approved locations off site without additional charge to the NFCU.

### 3.12 STOCKPILES

- A. Stockpiles shall be kept in a neat and well drained condition, giving due consideration to drainage at all times.
- B. The ground surface at stockpile locations shall be cleared, grubbed, and sealed by rubber-tired equipment, excavated satisfactory and unsatisfactory materials shall be separately stockpiled.
- C. Stockpiles of satisfactory materials shall be protected from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, such material shall be removed and replaced with satisfactory material from approved sources at no additional cost to NFCU.

### 3.13 REMOVAL OF UNYIELDING MATERIAL

- A. Where unyielding material is encountered in the bottom of the trench, such material shall be removed as directed by the Geotechnical Engineer and replaced with suitable materials as provided in section 3.14.

### 3.14 REPLACEMENT OF UNYIELDING MATERIAL

- A. Unyielding material removed from the bottom of the trench shall be replaced with select granular material or initial backfill material in layers not exceeding 6 inches loose thickness.

### 3.15 REMOVAL OF UNSTABLE MATERIAL



- A. Where unstable material is encountered in the bottom of the trench, such material shall be removed to the depth directed by the Geotechnical Engineer and replaced to the proper grade with select granular material as provided in section 3.16.
- B. When removal of unstable material is required due to the Contractor's fault or neglect in performing the work, the resulting material shall be excavated and replaced by the Contractor without additional cost to NFCU.

### 3.16 REPLACEMENT OF UNSTABLE MATERIAL

- A. Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 6 inches loose thickness.

### 3.17 EXCAVATION FOR APPURTENANCES

- A. Excavation for manholes, catch-basins, inlets, or similar structures shall be sufficient to leave at least 12 inches clear between the outer structure surfaces and the face of the excavation or support members.
- B. Rock shall be cleaned of loose debris and cut to a firm surface either level, stepped, or serrated, as shown or as directed by the Geotechnical Engineer. Loose disintegrated rock and thin strata shall be removed.
- C. Removal of unstable material shall be as specified above.
- D. When concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

### 3.18 JACKING, BORING, AND TUNNELING

- A. Jacking, Boring, and Tunneling shall be performed where indicated on the Drawings and shall and in accordance with the standards and specifications of the governing authority having jurisdiction.
- B. In situations where utility lines must be installed more than 15 to 20 feet below ground surface, through embankments, under minor roads or parking areas, or where surface conditions make it difficult or impractical to excavate open trenches, utility lines may be installed by jacking, boring, or tunneling as a contractor option.

### 3.19 TRENCH BOTTOM PREPARATION

- A. The bottoms of trenches shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe.
- B. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing.
- C. Stones of 1-1/2 inches or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.

### 3.20 BEDDING AND INITIAL BACKFILL

- A. Bedding shall be of the type and thickness shown on the drawings or as directed by the Geotechnical Engineer.

- B. Initial backfill material shall be placed and compacted with approved tampers to a height of at least one foot above the utility pipe or conduit. Do not place material on muddy or frozen surfaces or on surfaces containing frost.
- C. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe.

### 3.21 FILLING AND BACKFILLING

- A. Satisfactory materials are those conforming to the requirements of this specification, including the referenced geotechnical report and shall be used in (i) bringing fills and backfills to the lines and grades indicated; and, (ii) for replacing unsatisfactory materials.
- B. Satisfactory materials shall be placed in horizontal layers not exceeding 8 inches in loose thickness or 6 inches when hand-operated compactors are used. After placing, each layer shall be plowed, disked, or otherwise broken up, moistened or aerated as necessary, thoroughly mixed and compacted as specified.
- C. Backfilling shall not begin until construction below finish grade has been approved, underground utilities systems have been inspected, tested and approved, forms removed, and the excavation cleaned of trash and debris.
- D. Backfill shall not be placed in wet or frozen areas.
- E. Where pipe is coated or wrapped for protection against corrosion the backfill material, up to an elevation 2 feet above sewer lines and 1 foot above other utility lines, shall be free from stones larger than 1 inch in any dimension.
- F. Heavy equipment for spreading and compacting backfill shall not be operated closer to foundation or retaining walls than a distance equal to the height of backfill above the top of footing; the area remaining shall be compacted in layers not more than 4 inches in compacted thickness with power-driven hand tampers suitable for the material being compacted.
- G. Backfill shall be placed carefully around pipes or tanks to avoid damage to coatings, wrappings, or tanks.
- H. Backfill shall not be placed against foundation walls prior to 7 days after completion of the walls.
- I. As far as practicable, backfill shall be brought up evenly on each side of the wall and sloped to drain away from the wall.
- J. Each layer of fill and backfill shall be compacted to not less than the percentage of maximum density specified below:
  - 1. Fill, embankment, and backfill under structures, building slabs, steps, paved areas, around footings, and in trenches, 98%.
  - 2. Fill, embankment, and backfill under sidewalks, 95%.
  - 3. Fill, embankment, and backfill under grassed areas, 90%.
  - 4. Subgrade under building slabs, steps, and paved areas, top 12 inches, 100%.
  - 5. Subgrade under sidewalks, top 6 inches, 98%.
- K. Approved compacted subgrades that are disturbed by the Contractor's operations or adverse weather shall be scarified and compacted as specified herein to the required density prior to further construction thereon. Recomaction over underground utilities shall be by hand tamping.

### 3.22 TRENCH BACKFILL

- A. The trench shall not be backfilled until all of the following operations have been completed:
  - 1. Inspection, testing, and approval of underground utilities.
  - 2. Surveying of underground utilities for record documents.
  - 3. Removal of concrete formwork.
  - 4. Removal of loose material, muck, debris, and trash from excavation.
  - 5. Installation of temporary or permanent horizontal bracing for structures to receive backfill.

### 3.23 BACKFILL FOR APPURTENANCES

- A. After the manhole, catchbasin, inlet, or similar structure has been constructed and the concrete has been allowed to cure for a minimum of 7 days, backfill shall be placed in such a manner that the structure will not be damaged by the shock of falling earth.
- B. The backfill material shall be deposited and compacted as specified for final backfill, and shall be brought up evenly on all sides of the structure to prevent eccentric loading and excessive stress.

### 3.24 SUBGRADE PREPARATION

- A. Unsatisfactory material in surfaces to receive fill or in excavated areas shall be removed and replaced with satisfactory materials as directed by the Geotechnical Engineer.
- B. The surface shall be scarified to a depth of 6 inches before the fill is started.
- C. Sloped surfaces steeper than 1 vertical to 4 horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material.
- D. When subgrades are less than the specified density, the ground surface shall be broken up to a minimum depth of 6 inches, pulverized, and compacted to the specified density. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 12 inches and compacted as specified for the adjacent fill.
- E. Material shall not be placed on surfaces that are muddy, frozen, or contain frost.
- F. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted.
- G. Material shall be moistened or aerated as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used.
- H. Minimum subgrade density shall be as specified in section 3.21.

### 3.25 FINAL GRADE TO SUPPORT CONCRETE SURFACES

- A. Excavation to final grade shall not be made until just before concrete is to be placed.
- B. Only excavation methods that will leave the foundation rock in a solid and unshattered condition shall be used.

- C. Approximately level surfaces shall be roughened, and sloped surfaces shall be cut as indicated into rough steps or benches to provide a satisfactory bond.
- D. Shales shall be protected from slaking and all surfaces shall be protected from erosion resulting from ponding or flow of water.

### 3.26 CAPILLARY WATER BARRIER

- A. Capillary water barrier under concrete floor and area-way slabs on grade shall be placed directly on the subgrade and shall be compacted with a minimum of two passes of a hand-operated plate-type vibratory compactor.

### 3.27 GRADING

- A. Areas within 5 feet outside of each building and structure line shall be constructed true-to-grade, shaped to drain, and shall be maintained free of trash and debris until final inspection has been completed and the work has been accepted.

### 3.28 SPREADING TOPSOIL

- A. Areas outside the building lines from which topsoil has been removed shall be topsoiled.
- B. The surface shall be free of materials that would hinder planting or maintenance operations.
- C. The subgrade shall be pulverized to a depth of 2 inches by disking or plowing for the bonding of topsoil with the subsoil. Topsoil shall then be uniformly spread, graded, and compacted to the thickness, elevations, and slopes shown, and left free of surface irregularities.
- D. Topsoil shall be compacted by one pass of a cultipacker, roller, or other approved equipment weighing 100 to 160 pounds per linear foot of roller.
- E. Topsoil shall not be placed when the subgrade is frozen, excessively wet, extremely dry, or in a condition otherwise detrimental to seeding, planting, or proper grading.

### 3.29 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

- A. Gas Distribution System: Trenches shall be excavated to a depth that will provide not less than 18 inches of cover in rock excavation and not less than 24 inches of cover in other excavation unless otherwise required by the authority having jurisdiction. Trenches shall be graded as specified for pipe-laying requirements by the authority having jurisdiction or the supplying utility company.
- B. Water Lines: Trenches shall be of a depth to provide a minimum cover of 3 feet from the indicated finished grade to the top of the pipe unless otherwise required by the authority having jurisdiction.
- C. Electrical Distribution System: Direct burial cable and conduit or duct line shall have a minimum cover of 24 inches from the finished grade, unless otherwise required by the authority having jurisdiction.
- D. Plastic Marking Tape: Warning tapes shall be installed directly above the pipe, at a depth of 18 inches below finished grade unless otherwise required by the authority having jurisdiction.

### 3.30 PROTECTION

- A. Settlement or washing that occurs in graded, topsoiled, or backfilled areas prior to acceptance of the work, shall be repaired and grades reestablished to the required elevations and slopes.

### 3.31 TESTING

- A. Testing shall be performed by an approved commercial testing laboratory under the supervision of a licensed professional Geotechnical or Civil Engineer.
- B. Field In-Place Density Tests
  1. Field in-place density shall be determined in accordance with ASTM D1556, ASTM D2167, or ASTM D6938 as appropriate. When ASTM D6938 is used, the calibration curves shall be checked and adjusted if necessary by the procedure described in ASTM D6938, paragraph ADJUSTING CALIBRATION CURVE. ASTM D6938 results in a wet unit weight of soil and when using this method ASTM D3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D3017. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job, on each different type of material encountered, and at intervals as directed by the Geotechnical Engineer. ASTM D2937 shall be used only for soft, fine-grained, cohesive soils.
  2. Copies of calibration curves, results of calibration tests, and field and laboratory density tests shall be furnished to the Owner's Representative.
  3. In-place density and moisture content test results shall be included with the Contractor's daily construction quality control reports.
- C. In-Place Density of Subgrades: Conduct not less than one in-place density test of subgrade for every 2,500 square feet or fraction thereof of overlying paved areas and every 5,000 square feet or fraction thereof in building pad areas.
- D. In-Place Density of Fills and Backfills
  1. One test per 5,000 square feet or fraction thereof of each lift for fill or backfill areas compacted by other than hand or hand-operated machines.
  2. The density for each lift of fill or backfill materials for trenches, pits, building perimeters or other structures or areas less than 6 feet in width, which are compacted with hand or hand-operated machines shall be tested as follows: One test per each area less than 1,000 square feet, or one test for each 250 linear feet of long narrow fills 250 feet or more in length. In any case a minimum of one test shall be performed on all fills.
  3. Trenches improperly compacted shall be reopened to the depth directed, then refilled and compacted to the density specified at no additional cost to NFCU.
- E. Moisture Content
  1. In the stockpile, excavation or borrow areas, a minimum of two tests per day per type of material or source of materials being placed is required during stable weather conditions.
  2. During unstable weather, tests shall be made as dictated by local conditions and approved moisture content shall be tested in accordance with ASTM D2216.
- F. Optimum Moisture and Laboratory Maximum Density
  1. Tests shall be made for each type material or source of material, including borrow material to

determine the optimum moisture and laboratory maximum density values.

2. One representative test per 1500 cubic yards of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density will be made.

G. Displacement of Sewers

1. After other required tests have been performed and the trench backfill compacted to a minimum of 2 feet above the top of the pipe, the pipe shall be inspected to determine whether significant displacement has occurred. This inspection shall be conducted in the presence of the Inspector.
2. Pipe sizes larger than 36 inches shall be entered and examined, while smaller diameter pipe shall be inspected by shining a light or laser between manholes or manhole locations, or by the use of television cameras passed through the pipe.
3. If, in the judgement of the Inspector, the interior of the pipe shows poor alignment or any other defects that would cause improper functioning of the system, the defects shall be remedied as directed at no additional cost to NFCU.

**End of Section 312300**

## SECTION 313116 - SOIL TREATMENT FOR SUBTERRANEAN TERMITE CONTROL

### PART 1 - GENERAL

#### 1.1 SCOPE OF WORK

- A. The Contractor shall provide all labor, materials, equipment, and incidentals necessary for the following:
  - 1. Subterranean termite prevention treatment of soil areas scheduled to receive new construction, including:
    - a. Soil beneath slabs on grade.
    - b. Soil adjacent to shallow footings.
    - c. Soil adjacent to foundation walls.
    - d. Soil adjacent to foundations for columns, pillars, and other structures.
  - 2. Subterranean termite prevention treatment of new construction in progress.
  - 3. Subterranean termite control/prevention treatment of existing construction, including:
    - a. Soil beneath slabs on grade.
    - b. Soil adjacent to shallow footings.
    - c. Soil adjacent to foundation walls.
    - d. Soil adjacent to foundations for columns, pillars, and other structures.
    - e. Voids in masonry walls, including tile, brick, CMU, or other types of cavity walls and brick veneer.
    - f. Similar structures.

#### 1.2 REFERENCE DOCUMENTS

- A. Title 7, United States Code 136 through 136y -- Federal Insecticide, Fungicide, and Rodenticide Act as amended.

#### 1.3 SUBMITTALS

Comply with the applicable provisions of Section 01 33 00 Site Work Submittals.

- A. Project record documents:
  - 1. Submit a certificate signed by installer and contractor stating that treatment has been applied in accordance with applicable governing regulations and in accordance with this specification.
  - 2. Submit a manufacturer's label of the termiticide used.
  - 3. Incorporate into the certificate or attach thereto a plan drawing indicating actual application locations and, for each location, noting methods and rates of application and including typical sections or details where necessary for clarity.
- B. Warranty.
- C. Evidence of Surety Bond guaranteeing the fulfillment of warranty obligations of installer, and details of coverage using the same language as the bond itself.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications:
  - 1. A company installing products of this section and whose installations have been performed in a satisfactory manner under comparable conditions for a period of 5 years.

B. Regulatory Requirements:

1. Comply with applicable pesticide regulations of the state in which the project is located.
2. Comply with applicable local pesticide regulations.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Dispense product from manufacturer's original containers, with labels intact and bearing EPA registration number. Do not store in containers other than properly labeled containers.

1.6 WARRANTY

A. Special Warranty:

1. Submit installer's warranty against infestation of treated areas.
2. Warranty shall not reduce or otherwise limit any other rights to correction which the Navy Federal Credit Union may have under the contract documents.
3. Warranty period: 5 years.

B. Correction during the warranty period shall include not less than the following:

1. Retreatment of areas in which evidence of infestation is discovered.
2. Repairing, patching, removing, and reinstalling of building materials and soil materials when necessary to facilitate retreatment following infestation.
3. Restoration, repair, or replacement of building materials (including permanent fixtures) that become damaged by subterranean termites.

C. Installer shall be covered by a surety bond guaranteeing the fulfillment of warranty obligations of installer.

**PART 2 - PRODUCTS**

2.1 TERMITICIDE

- A. Registered with the United States Environmental Protection Agency (EPA) for use as a termiticide under conditions of use prevailing at the project site and shall be accepted by the U.S. Department of Agriculture for use in controlling termite infestation of buildings, without being injurious to plant life.
- B. Registered with the applicable authorities in the state in which the project is located and with local governing authorities, as applicable for use as a termiticide under conditions of use prevailing at the project site.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Verification of conditions in existing construction:

1. Conduct a thorough inspection of existing construction to determine presence of active or inactive infestation.
2. Should evidence of infestation be discovered, advise the Owner's Representative in writing.

B. Remove any existing termite tunnels encountered.



### 3.2 APPLICATION

- A. Apply termiticide in strict accordance with manufacturer's instructions.
- B. Apply termiticide at the maximum recommended application rates for the respective areas to be treated and methods of treatment used.
- C. Treat the entire structure. Do not leave any portion untreated.
- D. Schedule treatment of new construction to occur when treatment may be applied directly to the soils and surfaces to be treated, and prior to their concealment with subsequent construction.
- E. Treat existing construction by drilling, rodding, trenching, and making access openings as necessary to fully treat existing construction. Repair holes and openings and restore trenched areas, all to the satisfaction of the Owner's Representative.

### 3.3 CLEANING

- A. Do not allow contamination of surfaces not intended to be treated. Follow the manufacturer's instructions in order to completely remove chemicals from surfaces should contamination occur.
- B. Remove from beneath the structure any cellulosic material, wood that is not pressure-preservative treated, and debris. Do not allow non-pressure-preservative treated wood to contact with or remain proximate to soil.

**End of Section 313116**

## SECTION 320129 - PAVEMENT REPAIR AND RESTORATION

### PART 1 - GENERAL

#### 1.1 SCOPE OF WORK

- A. The Contractor shall provide all labor, materials, equipment and incidentals necessary to remove and replace pavements as indicated on the drawings.
- B. The Contractor shall provide barricades, warning signs, and warning lights around open excavations as necessary to prevent injury to persons.
- C. The Contractor is solely responsible for determining the potential for injury to persons and damage to property. Where such potential is present, the contractor shall take appropriate measures to protect persons from injury and protect existing and new improvements from damage caused directly or indirectly by construction operations.

#### 1.2 REFERENCE DOCUMENTS

- A. American Society for Testing and Materials
  - 1. ASTM D 6690 2007 Standard Specification for Concrete Joint Sealer, Hot-Applied Elastic Type (Withdrawn 2002)
- B. American Association of State Highway and Transportation Officials
  - 1. AASHTO M 324 Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements

#### 1.3 GENERAL

- A. All damage, as a result of work under this project, done to existing structures, pavement, driveways, paved areas, curbs and gutters, sidewalks, shrubbery, grass, trees, utility poles, utility pipe lines, conduits, drains, catch basins, rocked, graveled or stabilized areas or driveways and including all obstructions not specifically named herein, shall be repaired in a manner to restore the surface to its original condition. The scope of work shall include the furnishing of all labor, materials, equipment and incidentals necessary for the cutting, repair and restoration of the damaged areas.
- B. All materials and workmanship shall be first class and nothing herein shall be construed as to relieve the Contractor from this responsibility. Navy Federal Credit Union (NFCU) reserves the right to require testing or materials tests, should the adequacy or the quality of materials used be questionable. Costs of these tests shall be borne by NFCU.
- C. All street, road, driveway and highway repair shall be made in accordance with the details indicated on the Drawings.

### PART 2 - PRODUCTS

#### 2.1 ASPHALTIC CONCRETE PAVING

- A. The material shall be Type F, Bituminous Paving as specified Elsewhere in Division 2.

## 2.2 CRACK FILLER

- A. The crack filler shall be a hot applied type meeting the requirements of ASTM-D6690 2007, AASHTO-M173 and Fed. Spec. SS-S-164.

## PART 3 - EXECUTION

### 3.1 CUTTING PAVEMENT

- A. The Contractor shall cut and remove pavement as necessary for replacement as per the drawings. Make all cuts square or rectangular with faces straight and vertical.
- B. Before removing pavement, the pavement shall be marked. Asphalt pavements shall be cut along the markings with a rotary saw.
- C. No pavement shall be machine pulled until completely broken and separated along the marked cuts.

### 3.2 PAVEMENT REPAIR AND REPLACEMENT

- A. Remove the surface and asphalt base course as necessary to reach firm support, extending at least one foot into good pavement outside the cracked area. Re-work the subgrade and/or the existing aggregate base as necessary.
- B. Apply tack coat to all existing vertical faces.
- C. If new aggregate base is required to be installed, a prime coat shall applied.
- D. Backfill the hole with full-depth dense-graded hot asphalt plant-mix. Spread carefully to prevent segregation of the mixture. Compact in layers if the patch is more than 6 inches deep. Compaction should be done by vibration, plate or roller.
- E. Use a straightedge to check the quality and alignment of the patch.

### 3.3 CRACK REPAIR

- A. Clean the cracks with brooms and oil free compressed air.
- B. The crack is to be free of moisture, dust, loose aggregate or other contaminants.
- C. All cracks are to be cleaned and treated with a hot applied crack filler prior to seal coating.

### 3.4 CLEAN-UP

- A. After all repair and restoration or paving has been completed, all excess asphalt, dirt, rock and other debris shall be removed from the roadways. All existing storm sewers and inlets shall be checked and cleaned of any construction debris.

### 3.5 MAINTENANCE

- A. All wearing surfaces shall be maintained by the Contractor in good order and be suitable for traffic at all times for a period of one year after completion and acceptance of the work. Prior to the end of the maintenance period a final inspection will be made of the repaired surface and any settlement or depression shall be adjusted as previously noted herein.

**End of Section 320129**

## SECTION 321313 - PORTLAND CEMENT CONCRETE PAVING

### PART 1 - GENERAL

#### 1.1 SCOPE OF WORK

- A. The Contractor shall provide all labor, materials, equipment and incidentals necessary for the installation of portland cement concrete pavement. Including but not limited to the following:
  - 1. Formwork for pavements.
  - 2. Formwork accessories.
  - 3. Form stripping.
  - 4. Reinforcing steel for pavements.
  - 5. Cast-in-place concrete for pavements.
  - 6. Concrete curing.
- B. The Contractor shall provide barricades, warning signs, and warning lights around open excavations as necessary to prevent injury to persons.
- C. The Contractor is solely responsible for determining the potential for injury to persons and damage to property. Where such potential is present, the contractor shall take appropriate measures to protect persons from injury and protect existing and new improvements from damage caused directly or indirectly by construction operations.

#### 1.2 REFERENCES DOCUMENTS

- A. Texas Department of Transportation Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridge, 2004
- B. American Association of State Highway and Transportation Officials
  - 1. AASHTO M 148 – (2001) Liquid Membrane-Forming Compounds for Curing Concrete
  - 2. AASHTO M 171 – (2000) Sheet Materials for Curing Concrete
  - 3. AASHTO M 182 – (1991) Standard Specification for Burlap Cloth Made from Jute or Kenaf
- C. American Concrete Institute
  - 1. ACI 211.1 – Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
  - 2. ACI 301 – Specifications for Structural Concrete for Buildings
  - 3. ACI 302.1R – Guide for Concrete Floor and Slab Construction
  - 4. ACI 304R – Guide for Measuring, Mixing, Transporting, and Placing Concrete
  - 5. ACI 305R – Hot Weather Concreting
  - 6. ACI 325.9R – Guide for Construction of Concrete Pavements and Concrete Bases
  - 7. ACI 306.1 – Standard Specification for Cold Weather Concreting
  - 8. ACI 318-02 - Building Code Requirements for Structural Concrete
- D. American Society for Testing and Materials
  - 1. ASTM A 185 2007 Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
  - 2. ASTM A 615 2008 Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

3. ASTM C 31 2008a Standard Practice for Making and Curing Concrete Test Specimens in the Field
4. ASTM C 33 2007 Standard Specification for Concrete Aggregates
5. ASTM C 39 2005e1 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
6. ASTM C 42 2004 Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
7. ASTM C 94 2007 Standard Specification for Ready-Mixed Concrete
8. ASTM C 143 2008 Standard Test Method for Slump of Hydraulic Cement Concrete
9. ASTM C 150 2007 Standard Specification for Portland Cement
10. ASTM C 156 2005 Standard Test Method for Water Retention by Concrete Curing materials
11. ASTM C 171 2007 Standard Specification for Sheet Materials for Curing Concrete
12. ASTM C 172 2007a Standard Practice for Sampling Freshly Mixed Concrete
13. ASTM C 173 2008 Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
14. ASTM C 231 2008 Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
15. ASTM C 309 2007 Standard Specification for Liquid membrane-Forming Compounds for Curing Concrete
16. ASTM C 920 2005 Standard Specification for Elastomeric Joint Sealants.
17. ASTM C 1059 1999(2008) Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete
18. ASTM D 1751 2004 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

E. CRSI MSP - Manual of Standard Practice; Concrete Reinforcing Steel Institute

### 1.3 SUBMITTALS

Comply with the applicable provisions of Section 01 33 00 Site Work Submittals.

- A. Quality Control Submittals: Submit the following information related to quality assurance requirements specified:
1. Design data: Submit proposed mix designs and test data before concrete operations begin. Identify for each mix submitted the method by which proportions have been selected.
    - a. For mix designs based on field experience, include individual strength test results, standard deviation, and required average compressive strength  $f'(cr)$  calculations.
    - b. For mix designs based on trial mixtures, include trial mix proportions, test results, and graphical analysis and show required average compressive strength  $f'(cr)$ .
    - c. Indicate quantity of each ingredient per cubic yard of concrete.
  2. Certifications: Submit affidavits from an independent testing agency certifying that all materials furnished under this section conform to specifications.
  3. Delivery tickets: Submit copies of delivery tickets complying with ASTM C 94 for each load of concrete delivered to site. Include on the tickets the additional information specified in the ASTM document.
  4. Cold weather concreting: Submit description of planned protective measures.
  5. Hot weather concreting: Submit description of planned protective measures.
- B. Contractor shall submit certified laboratory reports on each additive material to the Owner's Representative.

### 1.4 QUALITY ASSURANCE

- A. Testing Agency Services:
  - 1. NFCU will engage testing agency to conduct tests and perform other services specified for quality control during construction.
  - 2. Contractor shall engage an independent testing agency to conduct testing necessary for design mix and material certification submittals.
- B. Source of Materials: Obtain materials of each type from same source for the entire project.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver reinforcement to project site bundled and tagged with metal tags indicating bar size, lengths, and other data corresponding to information shown on placement drawings.
- B. Store concrete reinforcement materials at the site to prevent damage and accumulation of dirt or rust.
- C. Store cementitious materials in a dry, weathertight location. Maintain accurate records of shipment and use.
- D. Store aggregates to permit free drainage and to avoid contamination with deleterious matter or other aggregates. When stockpiled on ground, discard bottom 6 inches of pile.
- E. Handle aggregates to avoid segregation.

#### 1.6 PROJECT CONDITIONS

- A. Cold-Weather Concreting: Comply fully with the recommendations of ACI 306. Well in advance of proposed concreting operations, advise the Owner's Representative of planned protective measures including but not limited to heating of materials, heated enclosures, and insulating blankets.
- B. Hot Weather Concreting: Comply fully with the recommendations of ACI 305R. Well in advance of proposed concreting operations, advise the Owner's Representative of planned protective measures, including but not limited to cooling of materials before or during mixing, placement during evening to dawn hours, fogging during finishing and curing, shading, and wind breaks.

### **PART 2 - PRODUCTS**

#### 2.1 FORMWORK

- A. Forms: Steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects. Use flexible spring steel forms or laminated boards to form radius bends as required.
  - 1. APA Exterior Plyform BB with a medium density, smooth, hard, fused resin fiber overlay, or metal forms.
  - 2. Single piece; depth equal to slab thickness.
  - 3. Base width at least three-fourths of form depth but not less than 8 inches, unless otherwise approved.
  - 4. Straightness tolerance: 1/8 inch in 10 feet from true plane surface along top; 1/4 inch in 10 feet along face.
  - 5. Locking provisions at ends of abutting form sections.
  - 6. Wood forms complying with the above provisions, including base and locking, may be used only

where form of less than 10 feet is required.

7. Wet screens will not be permitted.
8. Form Oil: Coat forms with nonstaining type coating that will not discolor or deface surface of concrete

- B. Curb, Curb and Gutter Forms: Use flexible spring-steel forms or laminated boards to form radius bends. Tolerance: Not to deviate more than 1/4 inch in 10 feet in grade and alignment.

## 2.2 REINFORCING MATERIALS

A. Reinforcing:

1. Welded Wire Mesh: Welded plain cold-drawn galvanized steel wire fabric, ASTM A 185. Furnish in flat sheets, not rolls, unless otherwise acceptable to the Owner's Representative.
2. Reinforcing Bars: Deformed steel bars, ASTM A 615, Grade 60.

B. Reinforcing Accessories:

1. Tie wire: Black annealed type, 16-1/2 gage or heavier.
  - a. Galvanized when used with galvanized reinforcing.
2. Supports: Bar supports conforming to specifications of CRSI "Manual of Standard Practice."
  - a. Precast concrete blocks of strength equal to or greater than specified strength of concrete or Class 3 supports equipped with sand plates, where concrete will be cast against earth. Concrete masonry units will not be accepted.
  - b. Dielectric-coated galvanized bar supports or supports of dielectric material or other approved material for all galvanized reinforcing bars.
3. Conform to Concrete Reinforcing Steel Institute Manual of Standard Practice. Include spacers and chairs with plastic tipped legs, ties and other devices necessary for properly assembling, placing, spacing and supporting forms and reinforcement in place.

## 2.3 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, and as follows:

1. Type I, except where other type is specifically permitted or required.
2. Type I maybe replaced by Type III (high early strength) for concrete placed during cold weather.

B. Water: Potable.

C. Aggregates: ASTM C33.

1. Fine aggregate shall be natural sand, or sand prepared from stone or gravel. Grains shall; be clean, hard, durable, uncoated and free from silt, loam and clay.
2. Coarse Aggregates: Crushed stone, gravel, or other approved inert materials of similar characteristics, or combinations thereof, having hard, strong, durable pieces free from adherent coatings. Maximum size of pieces shall be 3/4" to #4 except for footings, which may be 1-1/2". The maximum size of aggregate may also be not larger than one fifth of the narrowest dimension between forms, nor larger than three fourths of the minimum clear spacing between reinforcing bars.

D. Admixtures:

1. May be used at Contractor's option to provide workability at low slumps, increased compressive

strength, retardation or acceleration of the concrete.

2. Chemical Admixtures: ASTM C494.
  - a. Water-Reducing Admixture: ASTM C 494, Type A.
  - b. Water-Reducing, Retarding Admixture: ASTM C 494, Type D.
  - c. Water-Reducing and accelerating Admixtures: ASTM C 494 E.
  - d. High-Range Water-Reducing Admixture (Superplasticizer): ASTM C 494, Type F or G.
3. Mineral Admixtures: ASTM C618.
4. The cement factor shall not be reduced and changes shall be made in the other mix proportions to ensure the minimum strength requirements.
5. Use of admixtures approved in writing by the Owner's Representative. No additional expense to NFCU will be allowed.
6. No calcium chloride shall be used.
7. Before any admixture is accepted for use, the Contractor shall submit certified laboratory reports on each additive material to the Owner's Representative. The report shall show the following:
  - a. Confirmation of compliance with the applicable ASTM Standard.
  - b. Evaluation of the effects of the admixture on the properties of the concrete to be made on the job, including consideration of the anticipated ambient conditions on the job, and proposed construction procedures.
  - c. Determination of within-lot uniformity of product proposed for use.
8. Admixtures, which result in more than 0.1 percent of soluble chloride ions by weight of cement, are prohibited.

E. Air Entrainment: ASTM C260.

1. Use air-entrained concrete for exterior exposed concrete including walls, walks, paving, etc. where minimum daily temperatures are expected below 38 degrees F during pouring or subsequent 28 day curing period.
2. Proportion air-entraining concrete to attain minimum 28-day compressive strength specified.
3. Total Air Entrainment in Concrete: Not less than four percent nor more than six percent volume of concrete.

## 2.4 MISCELLANEOUS MATERIALS AND ACCESSORIES

- A. Bonding Compound: Non-redispersable acrylic bonding admixture, ASTM C 1059, Type II.
- B. Expansion Joint Filler: Nonextruding bituminous type: ASTM D 1751.

## 2.5 CONCRETE MIX DESIGN

A. Concrete Proportions:

1. Concrete shall be homogenous, and when hardened, shall have the required strength, resistance to deterioration, durability, water tightness and the properties as specified. Minimum concrete strength at 28 days shall be 3,000 psi unless otherwise specified on Drawings. Minimum 28-day compressive strength for concrete paving shall be 4,000 psi unless otherwise specified on the Drawings or by the Geotechnical Engineer.
2. Slump of concrete:
  - a. Slabs on ground: 2-1/2 inch minimum to 4 inch maximum.
  - b. Ramps and sloping surfaces: Not more than 3 inches.
3. Maximum water-cement ratio by weight: 0.40.
4. Maximum nominal size of coarse aggregate: As recommended in ACI 211.1.
5. Total air content as recommended by Table 1.4.3 of ACI 201.2 for maximum size of coarse aggregate and severe exposure.



6. Design mix to meet or exceed each requirement specified. Where more than one criterion is specified, the most stringent shall apply. For example, a minimum cement content or maximum water-cement ratio might result in strengths greater than the minimum specified; likewise, a greater cement content or lower water-cement ratio may be required in order to achieve the required strength.

- B. Ready-Mix Concrete:
1. Ready-mix concrete shall conform to ASTM C94. The mixing agitation shall begin within 30 minutes, and the concrete shall be discharged from the truck within one hour after the water has been added to the concrete mix.
  2. Delivery tickets are to accompany each concrete truck and shall be kept in the job superintendent's file. Delivery tickets must indicate the following information or be subject to rejection:
    - a. Name of project.
    - b. Supplier of concrete.
    - c. Truck identity and ticket serial number.
    - d. Date of delivery.
    - e. Brand of cement.
    - f. Cement content.
    - g. Strength classification.
    - h. Batching time.
    - i. Point of deposit.
    - j. Total amount of water.
    - k. Weight of aggregate.
    - l. Daily temperature.
    - m. Number of cubic yards in load.
    - n. Admixture content.
    - o. Name of Contractor.
    - p. Name of driver.
    - q. Time loaded and first mixing of concrete.
    - r. Reading of revolution counter.
  3. Quantity of water used for each batch shall be accurately measured.
- C. Admixtures:
1. Air-Entraining Admixture: Add at rate to achieve specified air content.
  2. Water-Reducing Admixture: Add as required for placement and workability.
  3. Water-Reducing and Retarding Admixture: Add as required in concrete mixes to be placed at ambient temperatures above 90° F.
  4. Water-Reducing and Accelerating Admixture: Add as required in concrete mixes to be placed at ambient temperatures below 50° F.
  5. High-Range Water-Reducing Admixture: (Superplasticizer): Add as required for placement and workability.
  6. Do not use admixtures not specified or approved.
- D. Mix Adjustments: Provided that no additional expense to NFCU is involved, Contractor may submit for the Owner's Representative's approval requests for adjustment to approved concrete mixes when circumstances such as changed project conditions, weather, or unfavorable test results occur. Include laboratory test data substantiating specified properties with mix adjustment requests.

## 2.6 CONTROL OF MIX IN THE FIELD

- A. Slump: A tolerance of up to 1 inch above approved design mix slump will be permitted for 1 batch in 5 consecutive batches tested. Concrete of lower slump than that specified may be used, provided proper placing and consolidation is obtained.
- B. Do not use batches that exceed tolerances.

## 2.7 JOINT MATERIALS

- A. Sealed expansion and contraction joints: Filler of nonbituminous rubber or cork conforming to ASTM D1752.
- B. Non-sealed joints: Filler premolded bituminous type conforming to ASTM D1751.
- C. Noncompressive Filler: 2 inch or 1 inch thick sheets.
- D. Compressive Filler: 2 inch or 1 inch thick sheets, compression modulus within the range of 15 to 25 pounds per square inch per inch.
- E. Filler Adhesive for Noncompressive Filler and Compressive Filler:
- F. Slab-on-grade Construction Joints: Provide a full slab depth 24 gauge metal preshaped key, approximate depth of key to be 1/4 slab thickness and a key width of about 1/10 slab thickness.
- G. Joint Sealants: ASTM C920. Non-priming, pourable, self-leveling polyurethane

## 2.8 CURING MATERIALS

- A. Burlap: AASHTO M 182, Class 2 jute or kenaf cloth.
- B. Moisture-Retaining Cover: AASHTO M 171, and as follows:
  - 1. White waterproof paper.
  - 2. Opaque-white polyethylene sheet, 0.006 inch thick.
- C. Sealers: ASTM C156 and ASTM C309, Type I. Material shall become integral part of concrete and leave slab free of residue or film.
- D. Membrane Curing Compound: Liquid membrane-forming compounds shall meet the requirements of AASHTO M148.

## PART 3 - EXECUTION

### 3.1 SUBGRADE PREPARATION

- A. Conform with the requirements specified elsewhere in Division 2.
- B. Thoroughly wet subgrade and then compact with two passes of a 500 pound roller.
- C. Pumping: Where concrete paving or sidewalks, and curbs are to be placed, yielding material deflecting more than 1/2 inch under a 500 lb. roller shall be removed to a depth of not less than 4 inches below subgrade elevation and replaced with an approved granular material which shall then be compacted as described above.
- D. The subgrade shall be in a moist condition when the concrete is placed. In cold weather the subgrade shall be prepared and protected so as to provide a subgrade free from frost when the concrete is deposited.

### 3.2 CONCRETE FORM PREPARATION

- A. General: Comply with requirements of ACI 325R-91 for formwork, and as herein specified. The Contractor is responsible for design, engineering, and construction of formwork, and for its timely removal.

- B. Construction: Construct and brace formwork to accurately achieve end results required by concrete documents, properly located and accurately aligned. Provide for screens, bulkheads, anchorages, and other features shown or otherwise required.
- C. Release Agent: Provide field-applied form coating. Thoroughly clean and recondition formwork and reapply coating before each use.
- D. Comply with the requirements of the Structural Engineer. Install sufficient quantity of forms to allow continuous progress of the work and so that forms can remain in place at least 24 hours after concrete placement.
- E. Check complete formwork for grade and alignment to the following tolerances:
  - 1. Top of form: Not more than 1/8 inch in 10 feet.
  - 2. Vertical face: Longitudinal axis not more than 1/4 inch in 10 feet.

### 3.3 CONNECTION TO EXISTING CONCRETE

- A. Preparation: At locations where new concrete is to join existing concrete, prepare existing surface by cleaning with wire brush and applying bonding compound in accordance with manufacturer's instructions.

### 3.4 PLACING REINFORCEMENT

- A. General: Comply with requirements of ACI 301 and as herein specified.
- B. Preparation: Clean reinforcement of loose rust and mill scale, soil, and other materials which adversely affect bond with concrete.
- C. Placement: Place reinforcement to achieve not less than minimum concrete coverage required for protection. Accurately position, support, and secure reinforcement against displacement. Provide Class C tension lap splices complying with ACI 318 unless otherwise indicated. Do not field-bend partially embedded bars unless otherwise indicated or approved.
  - 1. Use approved bar supports and tie wire, as required. Set wire ties to avoid contact with or penetration of exposed concrete surfaces. Tack welding of reinforcing is not permitted.
  - 2. Wire fabric: Install in maximum lengths possible, lapping adjoining pieces not less than one full mesh. Offset end laps to prevent continuous laps in either direction, and splice laps with tie wire.
- D. Welding: Welding of reinforcement is not permitted.
- E. Do not place concrete until reinforcement has been inspected and approved by local authorities, if required.

### 3.5 JOINT CONSTRUCTION

- A. General: Provide joints of the types and in the locations shown on the drawings.
  - 1. Construct joints in adjacent panels in precise alignment. Do not offset joints.
  - 2. Tool slab edges and formed joints with 1/8-inch radius jointing tool.
- B. Expansion Joints:
  - 1. Provide positive, firm support of filler during placement of concrete to ensure accurate alignment.
  - 2. Install expansion joint filler to the full concrete depth.

3. Recess top edge of filler to the depth indicated to accommodate joint sealant. Protect top edge of filler with removable metal channel while concrete is being placed, or provide filler with removable portion of the required depth.
4. Install transverse expansion joints at returns and 15 feet on center.
5. Install longitudinal expansion joints where curbs and paved areas abut each other, buildings, other concrete slabs and pads or vertical restraints.
6. Place joint filler with top edge 1/4" below the surface and shall be held in place with steel pins or other devices to prevent warping of the filler during floating and finishing.
7. Immediately after finishing operations are completed, round joint edges with edging tool having a radius of 1/8". Remove concrete over the joint filler.
8. At the end of the curing period, clean and fill expansion joints with joint sealer. Fill joints flush with concrete surface. Dummy groove joints shall not be sealed.

C. Sawn Contraction Joints:

1. Use only wet saws of an approved type.
2. Saw cut concrete as soon as the surface is firm enough so that it will not be damaged by the blade. The optimum time to cut the slab will be the Contractor's responsibility. Generally in moderate weather conditions, this time will be within 4 to 12 hours after the concrete is poured. This time will be earlier in hot or dry weather conditions. Concrete with shrinkage cracks will not be accepted.
3. Saw to one-fourth of slab depth.
4. Extend saw cut to full width of concrete section, including adjacent curbs and gutters, if any.
5. Membrane-cured surface damaged during the sawing operations shall be resprayed as soon as the surface becomes dry.

D. Curb Expansion Joints: Fill joints with 1/2 inch thick joint filler strips conforming to ASTM D1751 or ASTM D1752.

### 3.6 CONCRETE PLACEMENT

- A. Preparation: Provide materials necessary to ensure adequate protection of concrete during inclement weather before beginning installation of concrete.
- B. Inspection: Before beginning concrete placement, inspect formwork, reinforcing steel, and items to be embedded, verifying that all such work has been completed.
- C. Placement - General: Comply with requirements of ACI 304 and as follows:
1. Schedule continuous placement of concrete to prevent the formation of cold joints.
  2. If a section cannot be placed continuously, provide keyed construction joints with tie bars of size and spacing as approved by the Owner's Representative.
  3. Deposit concrete as close as possible to its final location, to avoid segregation.
- D. Slab Placement: Schedule continuous placement and consolidation of concrete within planned construction joints.
1. Thoroughly consolidate concrete without displacing reinforcement or embedded items, using internal vibrators, vibrating screens, roller pipe screens, or other means acceptable to the Owner's Representative.
- E. Cold Weather Placement: Comply with recommendations of ACI 306 when air temperatures are expected to drop below 40°F either during concrete placement operations or before concrete has cured.

1. Do not use frozen or ice-laden materials.
  2. Do not place concrete on frozen substrate.
- F. Hot Weather Placement: Comply with recommendations of ACI 305R when ambient temperature before, during, or after concrete placement is expected to exceed 90° F or when combinations of high air temperature, low relative humidity, and wind speed are such that the rate of evaporation from freshly poured concrete would otherwise exceed 0.2 pounds per square foot per hour.
1. Do not add water to approved concrete mixes under hot weather conditions.
  2. Provide mixing water at lowest feasible temperature, and provide adequate protection of poured concrete to reduce rate of evaporation.
  3. Use fog nozzle to cool formwork and reinforcing steel immediately prior to placing concrete.

### 3.7 FINISHING PAVEMENTS

A. Finishing Operations - General:

1. Do not directly apply water to slab surface or dust with cement.
  2. Use hand or powered equipment only as recommended in ACI 325.9R and 330R.
  3. Screening: Strikeoff to required grade and within surface tolerances indicated. Verify conformance to surface tolerances. Correct deficiencies while concrete is still plastic.
  4. Bull Floating: Immediately following screening, bull float or darby before bleed water appears to eliminate ridges, fill in voids, and embed coarse aggregate. Recheck and correct surface tolerances.
  5. Do not perform subsequent finishing until excess moisture or bleed water has disappeared and concrete will support either foot pressure with less than 1/4-inch indentation or weight of power floats without damaging flatness.
  6. Final floating: Float to embed coarse aggregate, to eliminate ridges, to compact concrete, to consolidate mortar at surface, and to achieve uniform, sandy texture. Recheck and correct surface tolerances.
- B. Broomed Float Finish: After floating and when water sheen has practically disappeared, apply uniform transverse corrugations approximately 1/16 inch deep, without tearing surface.
- C. Slab Surface Tolerances:
1. Achieve flat, level planes except where grades are indicated. Slope uniformly to drains.
  2. Flatness tolerance: Maximum depression between high spots when measured by placing a 10-foot straightedge on surface at any orientation: 3/16 inch.
- D. Repair of Slab Surfaces: Test slab surfaces for smoothness and to verify surface plane to tolerance specified. Repair defects as follows:
1. High areas: Correct by grinding after concrete has cured for not less than 14 days.
  2. Low areas: Immediately after completion of surface finishing operations, cut out low areas and replace with fresh concrete. Finish repaired areas to blend with adjacent concrete. Proprietary patching compounds may be used when approved by the Owner's Representative.

### 3.8 CONCRETE CURING AND PROTECTION

A. General:

1. Prevent premature drying of freshly placed concrete, and protect from excessively cold or hot temperatures until concrete has cured.

2. Provide curing of concrete by one of the methods listed and as appropriate to service conditions and type of applied finish in each case.
- B. Curing Period:
1. Not less than 7 days for standard cements and mixes.
  2. Not less than 4 days for high early strength concrete using Type III cement.
- C. Surfaces Not in Contact with Forms: Start curing as soon as free water has disappeared, but before surface is dry. Place to protect adjacent concrete edges. Acceptable curing methods include the use of burlap, moisture retaining covers, or curing compound as specified herein.
- D. Ensure that joints and slab edges receive adequate curing. Ensure that sawn joints receive adequate curing after sawing.
- E. During and following curing period, protect concrete from temperature changes of adjacent air in excess of 5° F per hour and 50° F per 24 hours. Progressively adjust protective measures to provide uniform temperature changes over entire concrete surface.

### 3.9 REMOVAL OF FORMS AND SUPPORTS

- A. Provided that concrete has hardened sufficiently that it will not be damaged, forms may be removed after concrete has cured at not less than 50° F for 8 hours. Maintain curing and protection operations after form removal.

### 3.10 BACKFILLING

- A. After curing, remove debris and backfill the adjoining areas, grade and compact to conform to the surrounding area in accordance with the lines and grades indicated.

### 3.11 QUALITY CONTROL TESTING DURING CONSTRUCTION:

- A. Composite Sampling, and Making and Curing of Specimens: ASTM C 172 and ASTM C 31.
1. Take samples at point of discharge.
  2. For pumped concrete, perform sampling and testing at the frequencies specified herein at point of delivery to pump, and perform additional sampling and testing at the same frequency at discharge from line. Results obtained at discharge from line shall be used for acceptance of concrete.
- B. Slump: ASTM C 143. One test per batch. Modify sampling to comply with ASTM C 94.
- C. Air Content of Normal Weight Concrete: ASTM C 173 or ASTM C 231. One test per strength test performed on Air-entrained concrete.
- D. Concrete Temperature:
1. Test hourly when air temperature is 40° F or below.
  2. Test hourly when air temperature is 90° F or above.
  3. Test each time a set of strength test specimens is made.
- E. Compressive Strength Tests: ASTM C 39.
1. Compression test specimens: Mold and cure one set of 4 standard cylinders for each compressive

- strength test required.
2. Testing for acceptance of potential strength of as-delivered concrete:
    - a. Obtain samples on a statistically sound, random basis.
    - b. Minimum frequency:
      - i. One set per 100 cubic yards or fraction thereof for each day's pour of each concrete class.
      - ii. One set per 3500 square feet of slab area or fraction thereof for each day's pour of each concrete class.
      - iii. When the above testing frequency would provide fewer than 5 strength tests for a given class of concrete during the project, conduct testing from not less than 5 randomly selected batches, or from each batch if fewer than 5.
    - c. Test one specimen per set at 7 days for information unless an earlier age is required.
    - d. Test 2 specimens per set for acceptance of strength potential; test at 28 days unless other age is specified. The test result shall be the average of the two specimens. If one specimen shows evidence of improper sampling, molding, or testing, the test result shall be the result of the remaining specimen; if both show such evidence, discard the test result and inform the Owner's Representative.
    - e. Retain one specimen from each set for later testing, if required.
    - f. Strength potential of as-delivered concrete will be considered acceptable if all of the following criteria are met:
      - i. No individual test result falls below specified compressive strength by more than 500 psi.
      - ii. Not more than 10 percent of individual test results fall below specified compressive strength  $f'(c)$ .
      - iii. Average of any 3 consecutive strength test results equals or exceeds specified compressive strength  $f'(c)$ .
    - g. Testing for evaluation of field curing:
      - i. Frequency: 1 field set of specimens per strength acceptance test.
      - ii. Mold specimens from same sample used for strength acceptance tests. Field-cure, and test at same age as for strength acceptance tests.
      - iii. Evaluate construction and curing procedures and implement corrective action when strength results for field-cured specimens are less than 85 percent of test values for companion laboratory-cured specimens.
- F. Test Results: Testing agency shall report test results in writing to the Owner's Representative and the Contractor within 24 hours of test.
1. Test reports shall contain the following data:
    - a. Project name, number, and other identification.
    - b. Name of concrete testing agency.
    - c. Date and time of sampling.
    - d. Concrete type and class.
    - e. Location of concrete batch in the completed work.
    - f. All information required by respective ASTM test methods.
  2. Nondestructive testing devices such as impact hammer or sonoscope may be used at the Owner's Representative's option for assistance in determining probable concrete strength at various locations or for selecting areas to be cored, but such tests shall not be the sole basis for acceptance or rejection.
  3. The testing agency shall make additional tests of in-place concrete as directed by the Owner's Representative when test results indicate that specified strength and other concrete characteristics have not been attained.
    - a. Testing agency may conduct tests of cored cylinders complying with ASTM C 42, or tests as directed.
    - b. Cost of additional testing shall be borne by the Contractor when unacceptable concrete



has been verified.

3.12 OPENING PAVEMENTS TO TRAFFIC

- A. Protect the completed work from damage. Repair damaged concrete and clean concrete discolored during construction. Remove work that is damaged and reconstruct to entire length between regularly scheduled joints. Refinishing damaged portion is not acceptable.
- B. Pavements may be opened to traffic only after 14 days have elapsed after placement and pavements have developed at least 85 percent of specified strength.

**End of Section 321313**

## SECTION 321613 - CONCRETE SIDEWALKS, CURBS, AND GUTTERS

### PART 1 - GENERAL

#### 1.1 SCOPE OF WORK

- A. The Contractor shall provide all labor, materials, equipment, and incidentals necessary for the construction of concrete sidewalks, curbs, and gutters.
- B. The Contractor shall provide barricades, warning signs, and warning lights around open excavations as necessary to prevent injury to persons.
- C. The Contractor is solely responsible for determining the potential for injury to persons and damage to property. Where such potential is present, the contractor shall take appropriate measures to protect persons from injury and protect existing and new improvements from damage caused directly or indirectly by construction operations.

#### 1.2 REFERENCE DOCUMENTS

- A. Texas Department of Transportation Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges, 2004
- B. American Association of State Highway and Transportation Officials
  - 1. AASHTO M 148 – (2001) Liquid Membrane-Forming Compounds for Curing Concrete
  - 2. AASHTO M 171 – (2000) Sheet Materials for Curing Concrete
  - 3. AASHTO M 182 – (1991) Standard Specification for Burlap Cloth Made from Jute or Kenaf
- C. American Society for Testing and Materials
  - 1. ASTM A 185 2007 Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
  - 2. ASTM A 615 2008 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
  - 3. ASTM A996 2006a Rail Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
  - 4. ASTM C 31 2008a Making and Curing Concrete Test Specimens in the Field
  - 5. ASTM C 143 2008 Slump of Hydraulic Cement Concrete
  - 6. ASTM C 156 2005 Standard Test Method for Water Retention by Concrete Curing materials
  - 7. ASTM C 171 2007 Sheet Materials for Curing Concrete
  - 8. ASTM C 172 2007a Sampling Freshly Mixed Concrete
  - 9. ASTM C 173 2008 Air Content of Freshly Mixed Concrete by the Volumetric Method
  - 10. ASTM C 231 2008 Air Content of Freshly Mixed Concrete by the Pressure Method
  - 11. ASTM C 309 2007 Standard Specification for Liquid membrane-Forming Compounds for Curing Concrete
  - 12. ASTM C 920 2005 Elastomeric Joint Sealants
  - 13. ASTM D 1751 2004 Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
  - 14. ASTM D 1752 2004a Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
  - 15. ASTM D 6690 2007 Joint Sealants, Hot-Applied, for Concrete and Asphalt Pavements

#### 1.3 SUBMITTALS

Comply with the applicable provisions of Section 01 33 00 Site Work Submittals.

Copies of all test reports shall be submitted within 24 hours of completion of the test.

#### 1.4 WEATHER LIMITATIONS

##### A. Placing During Cold Weather

1. Concrete placement shall not take place when the air temperature reaches 40 degrees F and is falling, or is already below that point. Placement may begin when the air temperature reaches 35 degrees F and is rising, or is already above 40 degrees F.
2. Provisions shall be made to protect the concrete from freezing during the specified curing period. If necessary to place concrete when the temperature of the air, aggregates, or water is below 35 degrees F, placement and protection shall be approved in writing. Approval will be contingent upon full conformance with the following provisions.
  - a. The underlying material shall be prepared and protected so that it is entirely free of frost when the concrete is deposited.
  - b. Mixing water and aggregates shall be heated as necessary to result in the temperature of the in-place concrete being between 50 and 85 degrees F. Methods and equipment for heating shall be approved.
  - c. The aggregates shall be free of ice, snow, and frozen lumps before entering the mixer.
  - d. Covering and other means shall be provided for maintaining the concrete at a temperature of at least 50 degrees F for not less than 72 hours after placing, and at a temperature above freezing for the remainder of the curing period.

##### B. Placing During Warm Weather

1. The temperature of the concrete as placed shall not exceed 85 degrees F except where an approved retarder is used.
2. The mixing water and/or aggregates shall be cooled, if necessary, to maintain a satisfactory placing temperature.
3. The placing temperature shall not exceed 95 degrees F at any time.

#### 1.5 EQUIPMENT, MACHINES, AND TOOLS

- A. Equipment, machines, and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times. The equipment shall have the capability of producing the required product, meeting grade controls, thickness control and smoothness requirements as specified. Use of the equipment shall be discontinued if it produces unsatisfactory results.
- B. Slip form pavers or curb forming machines, will be approved based on trial use on the job and shall be self-propelled, automatically controlled, crawler mounted, and capable of spreading, consolidating, and shaping the plastic concrete to the desired cross section in 1 pass.

#### 1.6 UTILITY PROTECTION

- A. Forty-eight (48) hours prior to excavation, the Contractor shall call the appropriate Utilities Protection Center to locate and protect existing utilities. Any damage to these utilities is to be repaired at no additional cost to Navy Federal Credit Union (NFCU). The Contractor is responsible for locating all utilities, either private or public.

### **PART 2 - PRODUCTS**

#### 2.1 CONCRETE

- A. Concrete shall conform to the applicable requirements of the Structural Engineer except as otherwise specified. Concrete shall have a minimum compressive strength of 3000 psi at 28 days. Maximum size of aggregate shall be 1-1/2 inches.
- B. Mixtures shall have air content by volume of concrete of 5 to 7 percent, based on measurements made immediately after discharge from the mixer.
- C. The concrete slump shall be 2 inches plus or minus 1 inch where determined in accordance with ASTM C 143.
- D. Reinforcement bars, if required or shown on the drawings, shall conform to ASTM A 615, ASTM A 996, or ASTM A 996. Wire mesh reinforcement shall conform to ASTM A 185.

## 2.2 CURING MATERIALS

- A. Burlap: AASHTO M 182, Class 2 jute or kenaf cloth.
- B. Moisture-Retaining Cover: AASHTO M 171, and as follows:
  - 1. White waterproof paper.
  - 2. Opaque-white polyethylene sheet, 0.006 inch thick.
- C. Sealers: ASTM C156 and ASTM C309, Type I. Material shall become integral part of concrete and leave slab free of residue or film.
- D. Membrane Curing Compound: Liquid membrane-forming compounds shall meet the requirements of AASHTO M148.

## 2.3 JOINT FILLER STRIPS

- A. Contraction joint filler for curb and gutter shall consist of hard-pressed 3/4 inch thick mineral fiberboard, asphalt impregnated, conforming to ASTM D1751.
- B. Expansion joint filler, premolded, shall conform to ASTM D 1751 or ASTM D 1752, 3/8 inch thick, unless otherwise indicated.

## 2.4 JOINT SEALANTS

- A. Joint sealant, cold-applied shall conform to ASTM C 920.
- B. Joint sealant, hot-poured shall conform to ASTM D 6690.

## 2.5 FORM WORK

- A. Form work shall be designed and constructed to ensure that the finished concrete will conform accurately to the indicated dimensions, lines, and elevations, and within the tolerances specified.
- B. Forms shall be of wood or steel, straight, of sufficient strength to resist springing during depositing and consolidating concrete. Wood forms shall be surfaced plank, 2 inches nominal thickness, straight, and free from warp, twist, loose knots, splits or other defects. Wood forms shall have a nominal length of 10 feet. Radius bends may be formed with 3/4-inch boards, laminated to the required thickness.
- C. Steel forms shall be channel-formed sections with a flat top surface and with welded braces at each

end and at not less than two intermediate points. Ends of steel forms shall be interlocking and self-aligning. Steel forms shall include flexible forms for radius forming, corner forms, form spreaders, and fillers. Steel forms shall have a nominal length of 10 feet with a minimum of 3 welded stake pockets per form. Stake pins shall be solid steel rods with chamfered heads and pointed tips designed for use with steel forms.

- D. Sidewalk forms shall be of a height equal to the full depth of the finished sidewalk.
- E. Curb and gutter outside forms shall have a height equal to the full depth of the curb or gutter. The inside form of curb shall have batter as indicated and shall be securely fastened to and supported by the outside form. Rigid forms shall be provided for curb returns, except that benders or thin plank forms may be used for curb or curb returns with a radius of 10 feet or more, where grade changes occur in the return, or where the central angle is such that a rigid form with a central angle of 90 degrees cannot be used. Back forms for curb returns may be made of 1-1/2 inch benders, for the full height of the curb, cleated together. In lieu of inside forms for curbs, a curb "mule" may be used for forming and finishing this surface, provided the results are approved.

### **PART 3 - EXECUTION**

#### **3.1 SUBGRADE PREPARATION**

- A. The subgrade shall be constructed to the specified grade and cross section prior to concrete placement. Subgrade shall be placed and compacted in conformance with Section 32 13 13 – PORTLAND CEMENT CONCRETE PAVING.
- B. Sidewalk subgrade shall be tested for grade and cross section with a template extending the full width of the sidewalk and supported between side forms.
- C. Curb and gutter subgrade shall be tested for grade and cross section by means of a template extending the full width of the curb and gutter. The subgrade shall be compacted graded aggregate based equal in bearing quality to the subgrade under the adjacent pavement.
- D. The subgrade shall be maintained in a smooth, compacted condition in conformity with the required section and established grade until the concrete is placed. The subgrade shall be in a moist condition when concrete is placed. The subgrade shall be prepared and protected to produce a subgrade free from frost when the concrete is deposited.

#### **3.2 FORM SETTING**

- A. Forms shall be set to the indicated alignment, grade and dimensions. Forms shall be held rigidly in place by a minimum of 3 stakes per form placed at intervals not to exceed 4 feet. Corners, deep sections, and radius bends shall have additional stakes and braces, as required. Clamps, spreaders, and braces shall be used where required to ensure rigidity in the forms.
- B. Forms shall be removed without injuring the concrete. Bars or heavy tools shall not be used against the concrete in removing the forms. Any concrete found defective after form removal shall be promptly and satisfactorily repaired.
- C. Forms shall be cleaned and coated with form oil each time before concrete is placed. Wood forms may, instead, be thoroughly wetted with water before concrete is placed, except that with probable freezing temperatures, oiling is mandatory.
- D. Forms for sidewalks shall be set with the upper edge true to line and grade with an allowable tolerance of 1/8 inch in any 10-foot long section. After forms are set, grade and alignment shall be checked with

a 10 foot straightedge. Forms shall have a transverse slope 1/4 inch per foot with the low side adjacent to the roadway unless noted otherwise. Side forms shall not be removed for 12 hours after finishing has been completed.

- E. The forms of the front of the curb shall be removed not less than 2 hours nor more than 6 hours after the concrete has been placed. Forms back of curb shall remain in place until the face and top of the curb have been finished, as specified for concrete finishing. Gutter forms shall not be removed while the concrete is sufficiently plastic to slump in any direction.

### 3.3 SIDEWALK CONCRETE PLACEMENT AND FINISHING

- A. Reinforcement steel shall be accurately and securely fastened in place with suitable supports and ties before the concrete is placed.
- B. Concrete shall be placed in the forms in one layer. When consolidated and finished, the sidewalks shall be of the thickness indicated. After concrete has been placed in the forms, a strike-off guided by side forms shall be used to bring the surface to proper section to be compacted. The concrete shall be consolidated with an approved vibrator, and the surface shall be finished to grade with a strike off.
- C. After straightedging, when most of the water sheen has disappeared, and just before the concrete hardens, the surface shall be finished with a wood float or darby to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks. A scored surface shall be produced by brooming with a fiber-bristle brush in a direction transverse to that of the traffic, followed by edging.
- D. All slab edges, including those at formed joints, shall be finished with an edger having a radius of 1/8 inch. Transverse joint shall be edged before brooming, and the brooming shall eliminate the flat surface left by the surface face of the edger. Corners and edges which have crumbled and areas which lack sufficient mortar for proper finishing shall be cleaned and filled solidly with a properly proportioned mortar mixture and then finished.
- E. Finished surfaces shall not vary more than 5/16 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch.

### 3.4 CURB AND GUTTER CONCRETE PLACEMENT AND FINISHING

- A. Concrete shall be placed to the section required in a single lift. Consolidation shall be achieved by using approved mechanical vibrators. Curve shaped gutters shall be finished with a standard curb "mule".
- B. Approved slipformed curb and gutter machines may be used in lieu of hand placement.
- C. Exposed surfaces shall be floated and finished with a smooth wood float until true to grade and section and uniform in texture. Floated surfaces shall then be brushed with a fine-hair brush with longitudinal strokes. The edges of the gutter and top of the curb shall be rounded with an edging tool to a radius of 1/2 inch. Immediately after removing the front curb form, the face of the curb shall be rubbed with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. The front curb surface, while still wet, shall be brushed in the same manner as the gutter and curb top. The top surface of gutter and entrance shall be finished to grade with a wood float.
- D. Curb edges at formed joints shall be finished as indicated.
- E. Finished surfaces shall not vary more than 1/4 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch.

### 3.5 SIDEWALK JOINTS

- A. Sidewalk joints shall be constructed to divide the surface into rectangular areas. Transverse contraction joints shall be spaced at a distance equal to the sidewalk width or 5 feet on centers, whichever is less, and shall be continuous across the slab. Longitudinal contraction joints shall be constructed along the centerline of all sidewalks 10 feet or more in width. Transverse expansion joints shall be installed at sidewalk returns and opposite expansion joints in adjoining curbs. Where the sidewalk is not in contact with the curb, transverse expansion joints shall be installed as indicated. Expansion joints shall be formed about structures and features which project through or into the sidewalk pavement, using joint filler of the type, thickness, and width indicated.
- B. The contraction joints shall be formed in the fresh concrete by cutting a groove in the top portion of the slab to a depth of at least one-fourth of the sidewalk slab thickness, using a jointer to cut the groove, or by sawing a groove in the hardened concrete with a power-driven saw, unless otherwise approved. Sawed joints shall be constructed by sawing a groove in the concrete with a 1/8 inch blade to the depth indicated. An ample supply of saw blades shall be available on the job before concrete placement is started, and at least one standby sawing unit in good working order shall be available at the jobsite at all times during the sawing operations.
- C. Expansion joints shall be formed with 1/2 inch joint filler strips. Joint filler shall be placed with top edge 1/4 inch below the surface and shall be held in place with steel pins or other devices to prevent warping of the filler during floating and finishing. Immediately after finishing operations are completed, joint edges shall be rounded with an edging tool having a radius of 1/8 inch and concrete over the joint filler shall be removed. At the end of the curing period, expansion joints shall be cleaned and filled with joint sealant.

### 3.6 CURB AND GUTTER JOINTS

- A. Curb and gutter joints shall be constructed at right angles to the line of curb and gutter.
- B. Contraction joints shall be constructed directly opposite contraction joints in abutting portland cement concrete pavements and spaced so that monolithic sections between curb returns will not be less than 5 feet nor greater than 15 feet in length. Contraction joints shall be constructed by means of 1/8 inch thick separators and of a section conforming to the cross section of the curb and gutter. Separators shall be removed as soon as practicable after concrete has set sufficiently to preserve the width and shape of the joint and prior to finishing.
- C. Expansion joints shall be formed by means of preformed expansion joint filler material cut and shaped to the cross section of curb and gutter. Expansion joints shall be provided in curb and gutter directly opposite expansion joints of abutting portland cement concrete pavement, and shall be of the same type and thickness as joints in the pavement. Where curb and gutter do not abut portland cement concrete pavement, expansion joints at least 1/2 inch in width shall be provided at intervals not exceeding 10 feet.

### 3.7 CURING AND PROTECTION

- A. Concrete shall be protected against loss of moisture and rapid temperature changes for at least 7 days from the beginning of the curing operation. Unhardened concrete shall be protected from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready for use before actual concrete placement begins. Protection shall be provided as necessary to prevent cracking of the pavement due to temperature changes during the curing period.
- B. Mat Method: The entire exposed surface shall be covered with 2 or more layers of burlap. Mats shall overlap each other at least 6 inches. The mat shall be thoroughly wetted with water prior to placing on concrete surface and shall be kept continuously in a saturated condition and in intimate contact with

concrete for not less than 7 days.

- C. Impervious Sheeting Method: The entire exposed surface shall be wetted with a fine spray of water and then covered with impervious sheeting material. Sheets shall be laid directly on the concrete surface with the light-colored side up and overlapped 12 inches when a continuous sheet is not used. The curing medium shall not be less than 18-inches wider than the concrete surface to be cured, and shall be securely weighted down by heavy wood planks, or a bank of moist earth placed along edges and laps in the sheets. Sheets shall be satisfactorily repaired or replaced if torn or otherwise damaged during curing. The curing medium shall remain on the concrete surface to be cured for not less than 7 days.
- D. Curing compound: Apply at rate stated by manufacturer to conform with moisture-retention requirements specified, using second, immediate application at right angle to first, if necessary, and reapply if damaged by rain.
- E. After curing, debris shall be removed and the area adjoining the concrete shall be backfilled, graded, and compacted to conform to the surrounding area in accordance with lines and grades indicated.
- F. Completed concrete shall be protected from damage until accepted. The Contractor shall repair damaged concrete and clean concrete discolored during construction at no additional cost to NFCU. Concrete that is damaged shall be removed and reconstructed for the entire length between regularly scheduled joints. Refinishing the damaged portion will not be acceptable. Removed damaged portions shall be disposed of as directed.

### 3.8 FIELD QUALITY CONTROL

- A. The Contractor shall perform the inspection and tests described and meet the specified requirements for inspection details and frequency of testing. Based upon the results of these inspections and tests, the Contractor shall take the action and submit reports as required below, and any additional tests to insure that the requirements of these specifications are met.
- B. The Contractor shall provide molded concrete specimens for strength tests. Samples of concrete placed each day shall be taken not less than once a day and no less than once for every 250 cubic yards of concrete. The samples for strength tests shall be taken in accordance with ASTM C 172. Cylinders for acceptance shall be molded in conformance with ASTM C 31 by an approved testing laboratory. Each strength test result shall be the average of 2 test cylinders from the same concrete sample tested at 28 days, unless otherwise specified or approved. Concrete specified on the basis of compressive strength will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified strength, and no individual strength test result falls below the specified strength by more than 500 psi.
- C. Air content shall be determined in accordance with ASTM C 173 or ASTM C 231. ASTM C 231 shall be used with concretes and mortars made with relatively dense natural aggregates. Two tests for air content shall be made on randomly selected batches of each class of concrete placed during each shift. Additional tests shall be made when excessive variation in concrete workability is reported by the placing foreman or the inspector. If results are out of tolerance, the placing foreman shall be notified and he shall take appropriate action to have the air content corrected at the plant. Additional tests for air content will be performed on each truckload of material until such time as the air content is within the tolerance specified.
- D. Two slump tests shall be made on randomly selected batches of each class of concrete for every 250 cubic yards, or fraction thereof, of concrete placed during each shift. Additional tests shall be performed when excessive variation in the workability of the concrete is noted or when excessive crumbling or slumping is noted along the edges of slip-formed concrete.
- E. The anticipated thickness of the concrete shall be determined prior to placement by passing a template



through the formed section or by measuring the depth of opening of the extrusion template of the curb forming machine. If a slip form paver is used for sidewalk placement, the subgrade shall be true to grade prior to concrete placement and the thickness will be determined by measuring each edge of the completed slab.

- F. The finished surface of each category of the completed work shall be uniform in color and free of blemishes and form or tool marks.

### 3.9 SURFACE DEFICIENCIES AND CORRECTIONS

- A. When measurements indicate that the completed concrete section is deficient in thickness by more than 1/4 inch the deficient section will be removed, between regularly scheduled joints, and replaced.
- B. In areas not meeting surface smoothness and plan grade requirements, high areas shall be reduced either by rubbing the freshly finished concrete with carborundum brick and water when the concrete is less than 36 hours old or by grinding the hardened concrete with an approved surface grinding machine after the concrete is 36 hours old or more. The area corrected by grinding the surface of the hardened concrete shall not exceed 5 percent of the area of any integral slab, and the depth of grinding shall not exceed 1/4 inch. Pavement areas requiring grade or surface smoothness corrections in excess of the limits specified above shall be removed and replaced.
- C. The Owner's Representative will inspect exposed surfaces of the finished work and any deficiencies in appearance will be identified. Areas which exhibit excessive cracking, discoloration, form marks, or tool marks or which are otherwise inconsistent with the overall appearances of the work shall be removed and replaced at no additional cost to NFCU.

**End of Section 231613**

## SECTION 321723 - PAVEMENT MARKINGS

### PART 1 - GENERAL

#### 1.1 SCOPE OF WORK

- A. The Contractor shall provide all labor, materials, equipment and incidentals necessary for the installation of road and parking striping and directional markings on asphaltic concrete and concrete paving including parking deck levels.
- B. The Contractor shall provide barricades, warning signs, and warning lights around the work area as necessary to prevent injury to persons.
- C. The Contractor is solely responsible for determining the potential for injury to persons and damage to property. Where such potential is present, the contractor shall take appropriate measures to protect persons from injury and protect existing and new improvements from damage caused directly or indirectly by construction operations.

#### 1.2 REFERENCE DOCUMENTS

- A. Texas Department of Transportation Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges, 2004

#### 1.3 SUBMITTALS

Comply with the applicable provisions of Section 013400 Site Work Submittals.

- A. Product data for marking paint and thermoplastic. Indicate application methods and rates.
- B. Manufacturer's current printed product description and Material Safety Data Sheets (MSDS) for each type paint/color proposed for use.

#### 1.4 DELIVERY AND STORAGE

- A. All materials shall be delivered and stored in sealed containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, manufacturer's name, and directions, all of which shall be plainly legible at time of use.

#### 1.5 EQUIPMENT

- A. All machines, tools and equipment used in the performance of the work shall be approved and maintained in satisfactory operating condition.
- B. Equipment operating on roads and runways shall display low speed traffic markings and traffic warning lights.

#### 1.7 MAINTENANCE OF TRAFFIC

- A. When traffic must be rerouted or controlled to accomplish the work, the necessary warning signs, flagpersons, and related equipment for the safe passage of vehicles shall be provided.

#### 1.8 WEATHER LIMITATIONS

- A. Apply pavement marking paint only when the ambient temperature in the shade is at least 50°F for 12 hours immediately prior to application.
- B. Do not apply when surface is wet or contains moisture.
- C. Do not apply paint when wind conditions would result in debris being deposited on painted surfaces.

## **PART 2 - PRODUCTS**

### **2.1 PAINT**

- A. The paint shall be homogeneous, easily stirred to smooth consistency, and shall show no hard settlement or other objectionable characteristics during a storage period of 6 months. The paint shall be capable of readily and uniformly dispersing to a complete homogeneous mixture providing good flowing and brushing properties capable of drying or curing free of streaks or sags.
- B. All paint shall comply with State Department of Transportation Standard Specifications or those of the authority with jurisdiction.

### **2.2 THERMOPLASTIC COMPOUNDS**

- A. The thermoplastic reflectorized pavement marking compound shall be extruded or sprayed in a molten state onto a primed pavement surface. Following a surface application of glass beads and upon cooling to normal pavement temperatures, the marking shall be an adherent reflectorized strip of the specified thickness and width that is capable of resisting deformation by traffic.
- B. All thermoplastic shall comply with State Department of Transportation Standard Specifications or those of the authority with jurisdiction.

### **2.3 PAVEMENT MARKING SCHEDULE**

- A. Pavement marking colors shall be as indicated below:
  - 1. Pedestrian Crosswalks: White.
  - 2. Exterior Sidewalk Curbs, Light Pole Bases and Bollards: Yellow.
  - 3. Fire Lanes: Red or per local code.
  - 4. Lane Striping Where Separating Traffic in Opposite Directions: Yellow.
  - 5. Lane Striping Where Separating Traffic in Same Direction: White.
  - 6. Handicap Symbols: Blue or per local code.
  - 7. Parking Stall Striping: White.

## **PART 3 - EXECUTIONS**

### **3.1 PREPARATIONS**

- A. Do not begin pavement marking until substrate has cured.
- B. Surfaces to be marked shall be thoroughly cleaned before application of the pavement marking material. Dust, dirt, and other granular surface deposits shall be removed by sweeping, blowing with compressed air, rinsing with water or a combination of these methods as required.

- C. Rubber deposits, surface laitance, existing paint markings, and other coatings adhering to the pavement shall be completely removed with scrapers, wire brushes, sandblasting, approved chemicals, or mechanical abrasion as directed. Areas of old pavement affected with oil or grease shall be scrubbed with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinsed thoroughly after each application. After cleaning, oil-soaked areas shall be sealed with cut shellac to prevent bleeding through the new paint.
- D. Pavement surfaces shall be allowed to dry, when water is used for cleaning, prior to striping or marking.
- E. Surfaces shall be recleaned, when work has been stopped due to rain.
- F. Where existing pavement markings are indicated on Drawings to be removed or would interfere with the adhesion of new paint, use a motorized abrasive device to remove existing markings.
  - 1. Use equipment that will not damage existing paving or create surface hazardous to vehicle or pedestrian traffic.
  - 2. Use marking removal methods approved by governing authority having jurisdiction in areas within public rights-of-way.

### 3.2 APPLICATION

- A. All pavement markings and patterns shall be placed as shown on the plans. All linework not otherwise indicated shall be 4" uniform thickness. All directional markings shall be painted using spray equipment and stencils or templates of approved design to prevent overspray.
- B. Paint
  - 1. Apply paint products in accordance with manufacturer's published instructions using application procedures approved for the particular application and substrate to the specified Minimum Dry Film Thickness (MDF). Apply each coat to uniform finish. Apply 2 coats at manufacturer recommended rate without addition of thinner, with maximum 100 square feet per gallon coverage.
  - 2. Paint shall be applied to clean, dry surfaces, and only when air and pavement temperatures are above 40 degrees F and less than 95 degrees F. Paint temperature shall be maintained within these same limits. Do not apply paint markings if rain is expected within 24 hours.
  - 3. New asphalt pavement surfaces and new Portland concrete cement shall be allowed to cure for a period of not less than 30 days before applications of paint.
  - 4. Paint shall be applied pneumatically with approved equipment at rate of coverage specified. The Contractor shall provide guide lines and templates as necessary to control paint application. Special precautions shall be taken in marking numbers, letters, and symbols. Edges of markings shall be sharply outlined.
  - 5. The maximum drying time requirements of the paint specifications will be strictly enforced to prevent undue softening of bitumen, and pickup, displacement, or discoloration by tires of traffic. If there is a delay in drying of the markings, painting operations shall be discontinued until cause of the slow drying is determined and corrected.
- C. Thermoplastic Compounds
  - 1. Thermoplastic shall be applied in accordance State Department of Transportation Standard Specifications or those of the authority with jurisdiction..
  - 2. Thermoplastic pavement markings shall be placed upon dry pavement; surface dry only will not be considered an acceptable condition. At the time of installation, the pavement surface

temperature shall be a minimum of 40 degrees F and rising. Thermoplastics, as placed, shall be free from dirt or tint.

3. All centerline, skipline, edgeline, and other longitudinal type markings shall be applied with a mobile applicator. All special markings, crosswalks, stop bars, legends, arrows, and similar patterns shall be placed with a portable applicator, using the extrusion method.
4. Immediately following application, reflective glass spheres shall be dropped onto the molten thermoplastic marking at the rate of 1 pound per 20 square feet of compound.

### 3.3 MARKING REMOVAL

- A. Pavement marking, including plastic tape, shall be removed in the areas shown on the drawings. Removal of marking shall be as complete as possible without damage to the surface. Aggregate shall not be exposed by the removal process.
- B. After the markings are removed, the cleaned pavement surfaces shall exhibit adequate texture for remarking as specified in paragraph 3.1. Contractor shall demonstrate removal of pavement marking in an area designated by the Owner's Representative. The demonstration area will become the standard for the remainder of the work.
- C. Equipment shall be controlled and operated to remove markings from the pavement surface, prevent dilution or removal of binder from underlying pavement, and prevent emission of blue smoke from asphalt or tar surfaces.
- D. The worksite shall be kept clean of debris and waste from the removal operations. Cleanup shall immediately follow removal operations. Debris shall be disposed of at approved sites.

**End of Section 321723**

## 328435 IRRIGATION SYSTEMS

### PART 1- GENERAL

#### 1.1 SYSTEM DESCRIPTION

- A. The sprinkler system shall include sprinklers, valves, piping fittings, controller, wiring, all of sizes and types as shown on the drawings and specified. The system shall be constructed to grades and conform to areas and locations as shown on the drawings.
- B. Sprinkler lines shown on the drawings are essentially diagrammatic. Spacing of the sprinkler heads or quick coupling valves are shown on the drawings and shall be exceeded only with written permission of the Designer.
- C. Unless otherwise specified or indicated on the drawings, the construction of the sprinkler system shall include the furnishing, installing, and testing of all mains, laterals, risers and fittings, sprinkler heads, gate valves, control valves, controllers, electric wire, controls, backflow preventers, enclosures, and other necessary specialties and the removal and/or restoration of existing improvements, excavating and backfill, and all other work in accordance with the plans and specifications a required for a complete system.

#### 1.2 QUALITY ASSURANCE

- A. Conference: Before any work is started a conference shall be held between the Contractor and the Owner concerning the work under this contract.
- B. The Contractor shall maintain continuously a competent superintendent, satisfactory to the Owner, on the work during progress with authority to act or him in all matter pertaining to the work.
- C. It is the Irrigation Contractor's responsibility to coordinate and cooperate with the other Contractors to enable work to proceed rapidly and efficiently.
- D. The Contractor shall confine his operations to the area to be improved and to the areas allotted him by the Designer and General Contractor for material and equipment.
- E. Contractor shall take all necessary measures to protect the existing site conditions and vegetation.

#### 1.3 SUBMITTALS

Comply with the applicable provisions of Section 013400 Site Work Submittals.

- A. General: Submit in accordance with Shop Drawings, Product Data, and Samples.
- B. Shop Drawings and Equipment Product Information:
  - 1. Prior to purchasing materials, submit product information on all sprinkler heads, automatic valves, quick coupling valves, controller, and pipe to be used on the project.
  - 2. Contractor shall review drawings and data to supply actual precipitation rates and times for each zone in maintenance package.
  - 3. Prior to trenching, Contractor shall submit proposed trenching equipment to Designer for approval.

C. Record Drawings and Instructions

1. Upon completion of installation, furnish one set of AutoCAD 2010 as built plans on disk and one set of printed record drawings showing all sprinkler heads, valves, drains, and pipelines to scale with dimensions. These drawings shall have dimensions from easily located stationary points as they relate to all valves, mainlines, and wire. Clearly note all approved substitutions of size, material, etc. Complete, concise instruction sheets and parts lists covering all operating equipment and weathering techniques shall be bound into folders and furnished to the Owner in three (3) copies. Submission of this information is a requirement for final acceptance.

1.4 SITE CONDITIONS

- A. The Contractor shall examine the site, plans and specifications.
- B. It shall be the Contractor's responsibility to report in writing to the Designer any deviations between drawings, specification, and the site. Failure to do so prior to the installing of equipment shall be done at the Contractor's expense.
- C. Adjustment of the sprinkler heads and automatic equipment will be done by the Contractor, upon completion of installation, to provide optimum performance.
- D. After completion, testing, and acceptance of the system, the Contractor shall verbally instruct the Owner's personnel in the operation and maintenance of the system. All written instruction shall be included in the bound maintenance package as stated in Paragraph 1.3 - Submittals.

1.5 CODES AND ORDINANCES

- A. All material, installation parameters, and operations shall conform to all applicable codes and ordinances. It is the Contractor's responsibility to investigate and follow all regulations. Before bid submittal it is the Contractor's responsibility to notify the Irrigation Consultant/Designer five days before bid opening of any changes due to current code or ordinances discrepancies. If the Contractor does not comply to this notification the Contractor shall be responsible for necessary installation change and redesign costs for non-compliance.

1.6 PERMITS AND FEES

- A. The Contractor shall obtain, at his expense, all required permits and shall pay all required fees. Any penalties imposed due to failure to obtain any permit or pay any fee shall be the responsibility of the Contractor.

1.7 WARRANTY AND GUARANTEE

- A. The Contractor shall furnish a certificate of warranty registration and a written guarantee of work and materials for a one year period from the date of final acceptance of the Irrigation System by the Owner and the Designer.

**PART 2 - PRODUCTS**

2.1 PIPE AND FITTINGS

- A. Pipe sizes shall conform to those shown on the drawings. No substitutions of smaller pipe sizes will be permitted, but substitutions of larger size may be approved. All pipe damaged or rejected because of defects shall be removed from the site at the time of said rejection.

- B. All piping 2 1/2" inches and larger will be equipped with gaskets.
- C. All fittings for pipes 2 1/2" or larger will be equipped with gaskets.
- D. All piping downstream of electric valves, sizes 3" and smaller, shall be rigid unplasticized PVC 200 PSI working pressure extruded from virgin parent material of the type specified on the drawings. The pipe shall be homogeneous throughout and free from visible cracks, holes, foreign materials, blisters, wrinkles and permanently marked with the manufacture's name, material, size, and schedule type. Pipe must bear the NFS seal.
- E. All mainline piping and underground piping under continuous pressure shall be rigid unplasticized schedule 40 pvc pipe extruded from virgin parent material of the type specified on the drawings. The pipe shall be homogeneous throughout and free from visible cracks, holes, and foreign materials, blisters, wrinkles and dents.
- F. All plastic fittings to be installed shall be molded fittings manufactured of the same material as the pipe and shall be suitable for solvent weld, slip joint ring tight seal, or screwed connections. NO fitting made of other material shall be used except as hereinafter specified.
- G. Slip fitting socket tapers shall be so sized that a dry unsoftened pipe end conforming to these special provisions can be inserted no more than halfway into the socket. Plastic saddle and flange fittings will not be permitted. Only Schedule 80 pipe may be threaded.

## 2.2 SLEEVES

- A. All sleeves shall be Class 200 PVC or stronger. All sleeves are required at every crossing indicated on drawings. (Size Noted)
- B. All sleeves shall be installed under proposed pavement areas prior to sub grade and base construction.
- C. Sleeves shall have a minimum horizontal separation of 18" and a maximum 24" clearance below bottom of curb.
- D. All sleeves shall have a minimum horizontal separation of 24" and maximum of 36" from center to center.
- E. Stub up sleeve pipe 12" above ground surface and cap. Paint cap with fluorescent orange paint for easy identification.
- F. The location of all sleeves shown on the plans is schematic. The contractor shall make any adjustments necessary to accommodate existing vegetation, utilities, or other existing conditions.
- G. If the road crossings are designated as being bore locations the bore must be ample size to accommodate the size sleeve specified.

## 2.3 CONTROL SYSTEM

- A. The automatic controller shall be as located on the outside wall of the building. The location shall be approved by the owner's representative.
- B. Install solar sync (rain/freeze sensor) shut off device to override the control timer in the event of rain or freeze.

## 2.4 CONTROL WIRE



- A. Control wire shall be type UF, UL approved, for direct burial and shall be gauge 14 or larger for the control wire and gauge 12 or larger for common wire.
- B. Joining of underground wires shall be made with watertight connectors in valve boxes. No splicing between boxes is acceptable.
- C. All wire connections in valve boxes; first example shall stay open until the Designer approves.

## 2.5 IRRIGATION VALVES

- A. Zone Control Valves
  - 1. Globe-type diaphragm valves of normally closed design, with bronze bodies or heavy-duty plastic and covers (type noted on drawings). Operation accomplished by means of an integrally mounted heavy-duty 24 volt AC solenoid complying with National Electrical Code, Class II Circuit, solenoid coil potted in epoxy resin within plastic-coated stainless steel housing. Solenoids shall be completely waterproof, suitable for direct underground burial. Provide a flow stem adjustment in each valve.

## 2.6 VALVE BOXES

- A. All valves shall be installed in thermoplastic valve access boxes of the size required to permit access to the valve. Valve boxes shall include black thermoplastic locking covers. Manufacturer - Ametek or approved equal.
- B. All valve boxes shall be installed on at least a 2 cubic foot gravel base to provide foundation and drainage.
- C. All valve box elevations shall be 1/2" below finished grade.

## 2.7 THRUST BLOCKS

- A. Place 1 cubic foot. of concrete for each 1" of pipe diameter for thrust block. Thrust shall not allow vertical or horizontal movement of pipe in any direction unless otherwise noted on design. Thrust blocking shall be provided on all piping 3" diameter and larger.

## PART 3 - EXECUTION

### 3.1 EXCAVATION AND BACKFILL

- A. Trenches for pipe sprinkler lines shall be excavated of sufficient depth and width to permit proper handling and installation by any other method the Contractor may desire if approved by the Owner, pipe manufacturer, and Designer. The backfill shall be thoroughly compacted and evened off with the adjacent soil level. Selected fill dirt or sand shall be used if soil conditions are rocky. In rocky areas the trenching depth shall be 2" below normal trenching depth to allow for this bedding. The fill dirt or sand shall be used in filling 4" above the pipe. The remainder of the backfill shall contain no lumps or rocks larger than 3". The top 12" of backfill shall be topsoil, free of rocks, subsoil, or trash. Any open trenches or partially backfilled trenches left overnight or left unsupervised shall be barricaded to prevent undue hazard to the public.
- B. The Contractor shall backfill in 6" compacted lifts as needed to bring the soil to its original density.
- C. In the spring following the year of installation, the Contractor shall repair any settlement of the trenches by bringing them to grade with topsoil, and seeding with the existing lawn type(s). Watering and maintenance of the repaired areas shall be the Owner's responsibility.

### 3.2 INSTALLATION OF PLASTIC PIPE

- A. Plastic pipe shall be installed in a manner that permits expansion and contraction as recommended by the manufacturer.
- B. Plastic pipe shall be cut with a handsaw or hacksaw with the assistance of a square in sawing vice or in a manner so as to ensure a square cut. Burrs at cut ends shall be removed prior to installation so that a smooth unobstructed flow will be obtained.
- C. All plastic-to-plastic joints shall be solvent weld joints or slip seal joints. Only the solvent recommended for the pipe and fittings shall be installed as outlined and instructed by the pipe manufacturer. The Contractor shall assume full responsibility for the correct installation.
- D. The joints shall be allowed to set at least 24 hours before pressure is applied to the system on PVC pipe.

### 3.3 CONTROLLER AND ELECTRICAL CONNECTIONS

- A. All electrical connections shall conform to the National Electrical Code, latest edition.
- B. Control wires installed beneath walks, drives, or other permanent surfaces shall be placed in sleeves.
- C. Wires shall be spliced only at valve boxes.
- D. Leave 24" loop of wire at each valve for expansion/contraction and servicing.
- E. Controllers and valves shall be from the same company e.g. (Rain Bird, Toro or approved equal).
- F. 120 VAC electrical power supply to the controller location shall be supplied by others.

### 3.4 FLUSHING AND TESTING

- A. After all new sprinkler piping and risers are in place and connected for a given section and all necessary division work has been completed and prior to the installation of sprinkler heads all control valves shall be opened and a full head of water used to flush out the system.
- B. Sprinkler main shall be tested under normal water pressure for a period of twelve 12 hours. If leaks occur, repair and repeat the test. Give Designer 24 hours notice prior to testing.
- C. Testing of the system shall be performed after completion of the entire installation and any necessary repairs shall be made at the Contractor's expense to put the system in good working order before final payment by the Owner.
- D. Adjustment of the sprinkler heads and automatic equipment will be done by the Contractor upon completion of installation to provide optimum performance. Minor adjustments during the guarantee period will be made by the Owner.
- E. After completion, testing, and acceptance of the system, the Contractor will instruct the Owner's personnel in the operation and maintenance of the system.

**End of Section 328435**

## SECTION 329300 - LANDSCAPING

### PART 1 - GENERAL

#### 1.1 SCOPE OF WORK

- A. This section includes furnishing labor, materials, equipment and services for all trees, shrubs, ground covers, bedding, installation, and related work required by the Drawings and Specifications.
- B. The Contractor's attention is directed to the fact that there are active utilities located within the limits of work. Before commencing any work required under the Contract, he shall find the location of all utilities, subsurface drainage, and underground construction and take proper precautions not to disturb or damage any subsurface improvements. The Contractor is responsible for all repairs to damaged utilities resulting from the work covered by this Contract without claims against the Owner for additional cost.
- C. The Contractor shall make a field examination of the project site for the purpose of verifying the following:
  - 1. Accuracy of all finish grades within the work area
  - 2. That drawing dimensions relate with actual field conditions.

The Contractor shall notify the owner's representative of any conditions that will prevent proper execution of the work.

#### 1.2 QUALITY ASSURANCE

- A. Reference Standards: Conform to recommendations, specifications and standards of the following:
  - 1. Standardized Plant Names, 1942 Edition, American Joint Committee on Horticultural Nomenclature.
  - 2. American Standard for Nursery Stock, 1980 Edition, American Association of Nurserymen.
- B. The selection of all materials and the execution of all operations required under the Specifications and Drawings shall be subject to the approval of the owner's representative. The owner's representative shall have the right to reject any or all materials and any or all work, which, in his opinion, does not meet the requirements of the Contract Documents at any stage of the operations. The Contractor shall move all rejected materials promptly from the site.
- C. The Landscape Contractor is hereby made aware that the Owner anticipates that the landscape installation of this facility shall be of the highest quality possible. To this end, the landscape contractor shall insure the following:
  - 1. All plant material shall be selected from the highest quality stock, and be specimen quality.

2. All work to be performed, such as preparing plant pits, installing plant mix, planting procedures, staking, guying, and pruning shall be strictly managed and executed and performed by experienced personnel.

A competent superintendent with on site decision making capacity will be present at all times.

### 1.3 SUBMITTALS

- A. The Contractor shall collect one soil sample, from areas to receive landscaping, for the purposes of testing. Each sample shall be approximately 1 KG in volume (approximately 1 gal. Ziploc bag) and shall receive the following test performed by A&L Agricultural Labs:
  1. S-1A
  2. S-3
  3. Texture Analysis

Test results shall be submitted to the owner's representative by successful bidder within 14 days following bid due date.

- B. Provide 5"x7" color photographs of all selected plant material at nursery. Show a 10' minimum measuring rod next to all trees. Label each picture with name and size of submittal. Submitted photograph are to be used for owner's representatives review for preliminary approval.
- C. List of Plant Material, Size, Remarks, Nursery Location.
- D. Date for trip to nursery to select and tag plant material.
- E. The landscape contractor shall submit bills of lading for all fertilizer tablets, soil amendments and Mycorrhizal tree inoculants to the owner's representative for review and verification of delivery to site.

### 1.4 GUARANTEE

- A. The guarantee period for all trees, plants, shrubs or ground covers shall begin at the date of final acceptance by the Owner's construction representative.
- B. The Contractor shall guarantee all plant materials for a period of one (1) year beginning at date of final acceptance of the Work in total. The Owner may either contract with the installation Contractor for maintenance or the Owner may follow the prescribed maintenance procedures. No replacements are necessitated by neglect or abuse by the Owner.

### 1.5 PLANT MATERIAL SELECTION & TAGGING

- A. Landscape Contractor to arrange a selection and tagging trip to nursery for the purpose of securing project plant material. All trips are to be made within ten hours. The landscape contractor shall notify the owner's representative when the material is ready for review. The Landscape Contractor shall participate in the visit.
- B. Landscape Contractor to provide locking straps for all selected plant material.

## PART 2 – PRODUCTS

### 2.1 PLANTS

#### LANDSCAPING

- A. Specific requirements concerning the various species and the manner in which they are to be furnished are shown in the drawings and plant list:
1. Quantity and Size: Plants shall be nursery grown except where noted, freshly dug, normally shaped and well branched, full foliated when in leaf and shall have healthy, well-developed root systems. Trees must be self-supporting, with straight trunks and with leaders intact. All plants furnished shall be free of insect infestations and eggs and shall have been grown under climatic conditions with temperature extremes similar to those of the locality of the project for a minimum of two (2) years prior to use on this project. All plants shall be true to species and variety. Plants used where symmetry is required shall match. Varieties common to an area (i.e. parking lot) shall match in height and form. The Landscape Architect will permit no substitutions without written permission.
  2. Material furnished in a size range specified shall be interpreted to mean that not less than 50% shall be of the maximum size specified within each range.
  3. The determining measurements for trees shall be caliper, height, and spread. Caliper shall be taken 6" above the ground for the trees up to and including 6" in caliper. Trees over 6" in caliper shall be measured at 12" above the ground line.
  4. Foliage Width and Origin: Must be measured across the mean foliage width dimension, not including random outstanding branches. Foliage height shall be measured from the top of the growing container or root ball to the top of plant not including random outstanding branches.
  5. Plants larger in size than those specified may be used with approval of the owner's representative at no additional cost to the Owner. If the use of larger plants is approved, the ball of earth or spread of roots shall be increased proportionately.
  6. Container-grown plants in containers or wooden boxes of equal quality as balled and burlapped plants may be substituted in lieu thereof. Plants grown in containers shall be delivered and remain in containers in a shady location until planted. Plants in containers shall be watered prior to transportation and shall be kept moist until planted. The container must be removed prior to planting, with care being exercised not to injure the plant.

## 2.2 AVAILABILITY

- A. If proof is submitted in writing that any plant specified is not obtainable by a minimum of five (5) reliable nursery sources which are members of The American Nurserymen's Association, then a proposal will be considered for use by the Landscape Architect of the nearest equivalent size or variety with no increase of contract price.

## 2.3 BURLAP

- A. Burlap for wrapping earth ball shall be made of jute and weigh not less than 7.02 oz. per square yard.

## 2.4 FOREST HUMUS OR PREPARED SOIL ADDITIVES

- A. Forest humus or prepared soil additives shall be air-dried, finely shredded, and suitable for horticultural purposes. Its pH value shall be between 5.5 and 6.5, and it shall contain no more than 35% moisture by weight.

## 2.5 MULCH

- A. Common landscape beds to receive pine straw mulch unless otherwise noted. Pine straw mulch shall be three inches deep, long-needle, red, clean, fresh, and free of branches, cones and foreign matter for all landscape areas unless otherwise noted.
- B. Flowerbeds to receive pine bark mini-nuggets, two inches deep.
- C. Provide flowerbeds with lava rock (miniature) for urban planters, three inches deep.

## 2.6 pH FACTOR READINGS

- A. The Contractor shall be responsible for neutralizing the soil to a pH reading of not less than 6 and not more than 7.5 by means described on the soils test performed by the specified agricultural soil testing laboratory.

## 2.7 COMMERCIAL FERTILIZER

- A. Commercial fertilizer shall be a complete fertilizer, 60% of the nitrogen of which is derived from natural organic sources or urea form. The following nitrogen-phosphorous-potash ratio types shall be applicable 16-4-8. It shall be delivered to the site in standard size unopened containers, showing weight, analysis, and name of manufacturer. It shall be stored in a weatherproof storage place in such a manner that it will be kept dry. Refer to soil test data prepared by specified testing facility for fertilizer analysis.
- B. Agriform 21 gram slow release fertilizer tablets shall be used for all tree and shrubs at the following rates:

### Fertilizer Tablet Application Rates

Container/Tree Size	No. of Tablets
4" Pots	1 tablet
1 gal.	1 tablet
3 gal.	3 tablets
7 gal.	5 tablets
15 gal.	10 tablets
1.5-3" cal. tree	20 tablets
3.5-5" cal. tree	30 tablets

- C. MycorTree Tree Saver Transplant (Mycorrhizal Transplant Inoculant) shall be incorporated into the backfill mix for all trees and shrubs per manufacturer's recommended rate of application.

## 2.8 GUYING AND STAKING

- A. See detail.

## 2.9 TREE GUYING SYSTEM

- A. Arborguy Guying System (Arborguy.com)

## 2.10 PLANTING SOIL MIX

- A. Planting soil mix backfill for all trees, shrubs and ground covers shall be prepared on site and shall consist of the following:
  - 1 part “Mr. Natural” CLM mix or approved equal to 2 parts existing soil.
- B. Perennial and Rose Bed Preparation (if applicable)  
The contractor shall prepare all perennial color beds as follows:
  - 1. Remove all weeds, rocks and debris from area to receive perennials.
  - 2. Place 6" depth of “Mr. Natural” CLM plant mix on area to receive perennial bed and cultivate into the existing soil to a depth of 12”.
  - 3. Crown bed to insure positive drainage.
- C. Annual Bed Preparation(if applicable):  
The contractor shall prepare all Annual color beds as follows:
  - 1. Remove all weeds, rocks and debris from area to receive annuals.
  - 2. Remove 6" depth of existing soil from entire annual bed and replace with 12" depth (crown of bed will be 6” above grade) of “Mr. Natural” CLM plant mix.
- D. Provide a pre-emergent weed killer to all landscape beds.

## 2.11 SOIL TO ACHIEVE A FINISHED GRADE

- A. The general contractor will be responsible for providing and placing soil to achieve a finished grade in all islands and planting areas; however, the landscape contractor shall be responsible for finish grading of all areas to receive landscape improvements including filling any voids or inequities in the areas backfilled by the general contractor, and insuring positive drainage of all landscape areas.

## 2.12 WATER

- A. Water will be available at the site.

## 2.13 CERTIFICATES OF INSPECTION

- A. Certificates of Inspection shall accompany the invoice for each shipment of plants as may be required by law for transportation. File Certificates with the owner’s representative prior to acceptance of the material. Inspection by Federal or State Governments at place of growth does not preclude rejection of plants at the site.

## 2.14 FIELD OBSERVATION OF PLANT MATERIALS PRIOR TO DIGGING

- A. The owner’s representative will observe trees or plants from the bidder's source for acceptability. In the event that the trees or plants are rejected, the Contractor shall pursue and examine other sources of plants until acceptable specimens are found. Such a change will not constitute an increase in cost to the Owner. Additional travel cost for tagging shall be borne by the contractor. Plants shall also be subject to field observation and approval by the owner’s representative for conformity to specification requirements. Such approval shall not impair the right of inspection and rejection during the progress of the Work. The Contractor shall inform the owner’s representative in writing of the plants he proposes to supply at least 20 calendar days prior to proposed digging dates.

## 2.15 PREPARATION, HANDLING AND DIGGING

- A. Prepare plants for shipment in a manner that will prevent any damage to the branches, shape or future development of the plant.
  - 1. Protection Against Drying Out: Handle plants so that roots, stems and branches are adequately protected at all times from drying out. Plants that cannot be planted immediately on delivery shall be kept in the shade, well protected with soil, wet moss or other acceptable material and shall be kept well watered. Plants shall not remain unplanted for longer than three (3) days after delivery.
  - 2. Digging: Retain as many fibrous roots as possible.
  - 3. Balled Plants: Plants designated "B & B" shall be adequately balled with firm natural balls of soil in sizes as specified in American Standard for Nursery Stock. Balls shall be firmly wrapped in burlap and securely tied with heavy twine or rope. Plants with loose, broken or manufactured balls will be rejected. Balls shall be lifted from the bottom only, not by stems or trunks.
  - 4. Delivery: All delivery vehicles shall be either enclosed van or covered by tarpaulin. Plants shall not be transported when the temperature is below 20 degrees F.

## PART 3 – EXECUTION

### 3.1 PLANTING

- A. All plants, deciduous and evergreens, shall be planted at such times of the year as the job may require, with the agreement of the Contractor to guarantee the material as herein specified.

### 3.2 LAYOUT OF MAJOR PLANTING

- A. Locations for plants and outlines of areas to be planted shall be approved by the owner's representative before excavation is begun. Review the applicable architectural and engineering drawings and be familiar with the alignment of underground utilities before digging. The Contractor shall be fully responsible for all damage of utility lines.

### 3.3 EXCAVATION OF PLANT TRENCHES AND PITS

- A. Dig pits as shown on planting details.
  - 1. Hardpan or Moisture Barrier: All tree pits must be loosened to a depth of two (2) feet below the bottom of the pit or to such depth that any hardpan has been broken and moisture is allowed to move through freely. If in the opinion of the Contractor the drainage is still not sufficiently handled relative to the life of the tree, the Contractor shall notify the owner's representative of such in writing before installing the trees in the questionable area; otherwise the Contractor is deemed to be totally responsible for the guarantee and livability of the tree.
  - 2. Notify the owner's representative in writing immediately of all/any soil conditions, which the Contractor considers detrimental to growth or survival of plant material. State conditions and submit proposal for correction, including cost of corrections. Obtain approval of method of correction before continuing the affected portion of the Work.



Alternate locations may be selected by the owner's representative and the Contractor shall prepare such areas with no additional cost to the Owner.

3. Prepare planting pits as specified, and as shown on the drawings, prior to inserting plants.
4. The planting area between the pits shall be filled to the required grade with clean soil from the excavation of the plant areas or with other acceptable soil. Until planting in area is finished, all plant beds shall be neatly edged and kept in this condition until the Work is accepted.
5. Once a tree or shrub is installed, prior to backfilling, the contractor shall place MycorTree Tree Saver Transplant (Plant Health Care) Inoculant and Agriform 21 gram Fertilizer tablets around each plant per the rate specified on the drawings or specifications. If application rate is not indicated in the contract documents, contractor shall use the manufacturer's specified rates. In addition to submitting certificates of delivery for fertilizer tablets, MycorTree Tree saver and soil amendments, the landscape architect will make random inspections of the planting operations and shall conduct soils test by independent agricultural lab to verify existence of soil amendments and Mycorrhizal tree inoculants per the specifications. Failure on the part of the contractor to provide delivery confirmation information requested above and/or failure on the part of the contractor to perform the work as specified will result in withholding of funds until such work has been successfully completed.
6. Planting beds shall be entirely cleaned of debris, roots, rocks, and vegetation prior to planting. Plants shall be evenly spaced in straight rows and set to finish grade requirements. Immediately spread pre-emergent herbicide per the manufacturer's recommended rate and apply specified mulch.

#### 3.4 SETTING PLANTS

- A. All plants shall be set so that when settled they will occur approximately 2" - 3" above the finished grade and also 2" - 3" above the grade that they bore to the natural grade before transplanting. Each plant shall be planted neatly in the center of the pit, and according to on-center spacing requirements. (Refer to Planting Details).
- B. Set plants plumb and brace rigidly in position until the planting soil mix has been tamped solidly around the ball and roots.
- C. Cut ropes, string or wire from top of the root ball after the plant has been set and lay open the burlap. Leave burlap or cloth wrapping intact around the edge of the root ball.
- D. Form shallow saucers to the finished grade outside the tree pit approximately 4" -6" in height capable of holding water about each plant by placing a mound of topsoil around the edge of each filled-in pit.

#### 3.5 FINISH GRADE OF PLANTING AREAS

- A. Raise planting areas to conform to specified grades after full settlement has occurred and before mulch has been applied.

#### 3.6 WATER

- A. Water (soak) all plants immediately after planting, and continue thereafter as necessary until acceptance of the Work in total.

### 3.7 MULCHING

- A. Immediately after the work of planting and watering has been completed, a layer of pine straw mulch 3" thick shall be placed on the finished surface about the plant. The mulch around isolated plants shall cover the entire area of the pit. Where plants are planted in groups, the area about, as well as the entire area between, the plants shall be covered with mulch.

### 3.8 STAKING, GUYING AND PRUNING

- A. Staking shall be completed immediately after planting. Plants shall stand plumb after staking in accordance with the detail drawings.
- B. Staking Trees 8 Ft. High and Under: Stake immediately as shown on the drawings after planting and maintain stakes and guying straps until acceptance. Unless otherwise approved, drive stakes securely into the ground and fasten to the tree with guying straps. Trees under 2" caliper or eight (8) feet in height should be supported by two (2) wood stakes and guying straps as indicated on landscape details. Alternate staking details may be submitted for approval by the owner's representative before planting begins.
- C. Guying trees taller than 8' shall be done with three (3) guys of guying straps spaced equally about each tree. Each guy shall consist of guying straps attached to the tree trunk at an angle of about 60 degrees and at about two-fifths the height of the tree and anchored at the ground either to notched stakes or steel rods which must be driven into the ground so that the top will be below finished grade.
- D. Pruning of deciduous material (except sidewalk street trees) shall be limited to the removal of injured twigs and branches. Leave intact the normal shape of the plant unless otherwise directed by the Landscape Architect.
- E. Additional pruning will be required on street trees located in sidewalk planters to allow for visibility to storefront signage. All trees with central leader shall be pruned to a clear trunk height of 8' and all secondary growth (twigs and leaves) shall be removed to a height of 12'. All sidewalk trees with without central leader shall be pruned to remove all secondary branches and leaves to a height of 12'.

### 3.9 INTERIM MAINTENANCE OF TREES AND SHRUBS

- A. Maintenance shall begin immediately after each plant is planted and shall continue until final acceptance of the Work in total by the owner's representative with the following requirements:
  - 1. Maintenance of new planting shall consist of pruning, watering, cultivating, weeding, mulching, tightening and repairing of guys, resetting plants to proper grades or upright position, restoration of planting saucer, and furnishing, supplying, and applying such sprays as are necessary to keep the plantings free of insects and diseases. If planting is performed after grass area preparation, proper protection to grass areas shall be provided, and any damage resulting from planting operations repairs promptly. Contractor shall provide interim maintenance until the time of final acceptance of the Work in total by the Landscape Architect upon completion of all Work under this contract.
  - 2. Planting areas and plants shall be protected at all times against trespassing and damages of any kind for the duration of the maintenance period. If any plants become damaged or injured, they shall be treated or replaced as directed by the owner's representative at no

additional cost to the Owner. No work shall be done within, adjacent to, or over any plant or planting area without proper safeguards and protection to the plant material.

3. The Contractor shall be responsible for keeping all planting and work incidental thereto in good condition by replanting, replacing, watering, weeding, cultivating, pruning, spraying, re-guying, and performing all other necessary operations to care for promotion of root growth and plant life so that work is in satisfactory condition at final acceptance.
4. The root systems of all plants shall be watered at such intervals as will keep the surrounding soil in the best condition for promotion of root growth and plant life.
5. Sidewalks, streets and other paved areas shall be continuously kept clean when planting and maintenance operations are in progress, and the entire work area shall be cleaned at the end of each day's work.

### 3.10 OWNER'S ACCEPTANCE

- A. The completion of the contract will be accepted and Notice of Completion recorded only when the entire contract is completed to the satisfaction of the Owner..
- B. Within ten (10) days of the Contractor's notification that the installation is complete, the Owner's construction representation will inspect the installation and if a final acceptance is not given, will prepare a "Punch List" indicating work that does not conform to the plans and specifications. Prior to final acceptance, the Contractor shall complete all items on the punch list. All items on the "Punch List" must be completed before additional "Punch List" trips are provided. Notify the owner's representative in writing that all "Punch List" items are complete. All costs associated with additional "Punch List" review trips caused by the contractor's lack of preparation, completion, or neglect will be the responsibility of the Landscape Contractor.

### 3.11 TERMINATION OF MAINTENANCE

- A. The Contractor's responsibility for complete maintenance (exclusive of replacement) shall terminate on the date of final acceptance of the Work in total unless the Maintenance Agreement is accepted, whereas the contractor shall continue maintenance of the project for a period of one (1) year following the date of the final acceptance of the work.

### 3.12 MONTHLY INSPECTION

- A. The Contractor shall make monthly inspections, at no extra cost to the Owner, during the guarantee period to determine what changes, if any, should be made in the maintenance program. All such recommended changes shall be submitted in writing to the Owner.

### 3.13 PLANT REPLACEMENT

- A. The Contractor shall replace without cost to the Owner, and as soon as weather conditions permit, all dead plants and all plants not in a vigorous, thriving condition, as determined by the owner's representative during and at the end of the one (1) year guarantee period. Replacement shall match adjacent specimens of the same species, and shall be subject to selection in the field by the owner's representative prior to digging. Replacements shall be subject to requirements in this specification.

### 3.14 CONTRACTOR LIABILITY

- A. The Contractor shall make all necessary repairs to grades, lawn areas, and paving required because of plant replacements. Such repairs shall be done at no extra cost to the Owner.

### 3.15 REPLACEMENT PLANT ACCEPTANCE

- A. The acceptance of all replacement plants by the owner's representative shall terminate the Contractor's liability for such. In the event that a replacement plant dies, the Owner may elect a substitution.

### 3.16 CLEARING OF GROUND

- A. Upon completion of the Work, the grounds shall be cleared of all debris, superfluous materials, and equipment, which shall be entirely removed from the premises to the satisfaction of the Owner.

**End of Section 329300**

## **SECTION 329300.01 – FINISH GRADING**

### **PART 1 – GENERAL**

#### **1.1 DESCRIPTION**

This section covers furnishing all labor, materials, equipment, tools, and incidentals necessary to finish grade the landscaped areas shown on the drawings. This section includes work along roadways, in parking islands and planters adjacent to buildings.

### **PART 2 – EXECUTION**

#### **2.1 BACKFILLING**

- A. The general contractor shall be responsible for rough grading all site areas to within  $\pm .20$  of a foot of final proposed grades. The landscape contractor will be responsible for fine grading of parking islands as well as backfilling of low spots or inequities in parking islands, medians, behind curbs, and all other landscaped areas on site. Any additional soil needed to correct the grade inequities left by the general contractor may be available on site.
- B. The general contractor is responsible for backfilling all planters up to the bottom of the sidewalk slab. The landscape subcontractor shall be responsible for backfilling the planters as required to provide for positive drainage away from the buildings and out of planters.

#### **2.2 LANDSCAPE BERM SHAPING**

- A. The landscape contractor shall be responsible for final shaping of all landscape berms in parking islands, landscape areas and road frontages at the direction of the Landscape Architect. Landscape contractor shall be responsible for the removal and off-site disposal of all debris collected during the berm grading operations.

#### **2.3 PREPARATION FOR LAWNS**

- A. The landscape contractor shall be responsible for fine grading with a small rubber tired tractor all the areas on site to receive lawn type grassing and sodding. The landscape architect will inspect all fine graded areas for approval prior to grassing operations.

### **PART 3 - OWNER'S ACCEPTANCE**

- A. The landscape contractor is responsible for maintaining the finish grades until final acceptance by the Owner or Owner's representative. Repairs required resulting from negligence are at the contractor's expense.

**End of Section 329300.01**

## SECTION 331100 – WATER DISTRIBUTION SYSTEM

### PART 1 - GENERAL

#### 1.1 SCOPE OF WORK

- A. The Contractor shall provide all labor, materials, equipment and incidentals necessary for the installation of the water distribution system. Including but not limited to the following:
  - 1. Domestic water system pipe and fittings.
  - 2. Connection of domestic water system to municipal water system.
  - 3. Fire protection water system pipe, fittings, valves, and hydrants.
  - 4. Connection of fire protection water system to municipal water system
- B. The construction required herein shall include constructing water lines to points of connection with the building lines 5 feet outside the building to which the water distribution system is to be connected. The Contractor shall replace damaged material and redo unacceptable work at no additional cost to Navy Federal Credit Union (NFCU). Excavation and backfilling is specified in Section 31 23 00.00 20 - EXCAVATION, FILLING, AND BACKFILLING FOR BUILDINGS AND UTILITY SYSTEMS. Backfilling shall be accomplished after inspection by the Geotechnical Engineer. The Contractor shall have a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the Engineer.
- C. The Contractor shall provide barricades, warning signs, and warning lights around open excavations as necessary to prevent injury to persons.
- D. The Contractor is solely responsible for determining the potential for injury to persons and damage to property. Where such potential is present, the contractor shall take appropriate measures to protect persons from injury and protect existing and new improvements from damage caused directly or indirectly by construction operations.

#### 1.2 REFERENCE DOCUMENTS

- A. City of Westworth Village, Texas Water Department Standards and Specifications.
- B. American Society for Testing and Materials
  - 1. ASTM D412 2006a Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension
  - 2. ASTM D624 2000(2007) Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
  - 3. ASTM D1056 2007 Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber
  - 4. ASTM D1171 1999(2007) Standard Test Method for Rubber Deterioration-Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens)
  - 5. ASTM D1784 2007 Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
  - 6. ASTM D1599 1999(2005) Standard Test Method for Resistance to Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings
  - 7. ASTM D2241 2005 Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
  - 8. ASTM D2564 2004e1 Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems

9. ASTM D2774 2008 Standard Practice for Underground Installation of Thermoplastic Pressure Piping
  10. ASTM D2855 1996(2002) Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
  11. ASTM D3139 1998(2005) Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
  12. ASTM F477 2007 Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- C. American Water Works Association
1. AWWA B300-04: Hypochlorites
  2. AWWA B301-04: Liquid Chlorine
  3. AWWA C500-02: Metal-Sealed Gate Valves for Water Supply Service
  4. AWWA C502-05: Dry-Barrel Fire Hydrants
  5. AWWA C503-05: Wet-Barrel Fire Hydrants
  6. AWWA C504-06: Rubber-Seated Butterfly Valves
  7. AWWA C509-01: Resilient-Seated Gate Valves for Water Supply Service
  8. AWWA C651-05: Disinfecting Water Mains
  9. AWWA C800-05: Underground Service Line Valves and Fittings (Also Included: Collected Standards for Service Line Materials)
  10. AWWA C900-97: Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings 4 In. - 12 In., for Water Dist.
  11. AWWA C905-97 Polyvinyl Chloride (PVC), Pressure Pipe, and Fabricated Fittings 14 In. - 36 In.
  12. AWWA Manual M23 PVC Pipe Design and Installation
- D. Manufacturers Standardization Society of the Valve and Fittings Industry
1. MSS SP-80(1997) Bronze Gate, Globe, Angle and Check Valves
- E. National Fire Protection Association
1. NFPA 24: Standard for the Installation of Private Fire Service Mains and Their Appurtenances
  2. NFPA 49(1994) Hazardous Chemicals Data
  3. NFPA 325-1(1994) Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids
  4. NFPA 704: Standard System for the Identification of the Fire Hazards of Materials for Emergency Response
  5. NFPA 196: Standard on Fire Hose
- F. NSF International
1. NSF 14(1998) Plastics Piping Components and Related Materials
  2. NSF 61(1999) Drinking Water System Components - Health Effects (Sections 1-9)

### 1.3 SUBMITTALS

Comply with the applicable provisions of Section 01 33 00 Site Work Submittals.

- A. Submit, within thirty (30) days after execution of the contract, the manufacturer's certificate of compliance or certified analysis in accordance with applicable standards for each shipment of materials.
- B. Samples of the products used.

- C. Printed copies of the manufacturer's recommendations for installation procedures of the material being placed, prior to installation.
- D. Complete shop drawings of all pipes, valves, structures and appurtenances shall be submitted for review.
- E. The method proposed for disposal of waste water from hydrostatic tests and disinfection, prior to performing hydrostatic tests.
- F. Project Record Documents: Accurately record the following:
  - 1. Actual locations of pipe runs, connections, and top of pipe elevations.
  - 2. Test results from commercial laboratory verifying disinfection.
  - 3. Identify and describe unexpected variations to subsoil conditions and location of uncharted utilities.
- G. Submit As-Builts for all components of the domestic and fire water distribution system, such as pipes, valves, and structures.

#### 1.4 QUALITY ASSURANCE

- A. The types of valves and appurtenances shall be the products of firms fully experienced and qualified in the manufacture of the particular material to be furnished. The manufacturer's name and pressure rating shall be marked on the valve body.
- B. All additional temporary piping, pumps, and equipment necessary for the successful testing of the system is to be provided by the Contractor.
- C. All materials to meet the requirements of the governing authority.
- D. System Testing: All additional temporary piping, pumps and equipment necessary for the successful testing of the system to be provided by the contractor
- E. Regulatory Requirements: Perform work in accordance with utility company requirements and local authority having jurisdiction requirements.

#### 1.5 PRODUCT HANDLING AND STORAGE

- A. Pipe and accessories shall be handled to ensure delivery to the trench in sound, undamaged condition, including no injury to the pipe coating or lining. If the coating or lining of any pipe or fitting is damaged, the repair shall be made by the Contractor in a satisfactory manner, at no additional cost to NFCU.
- B. No other pipe or material shall be placed inside a pipe or fitting after the coating has been applied.
- C. Pipe shall be carried into position and not dragged. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe.
- D. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method.
- E. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to NFCU.
- F. Rubber gaskets that are not to be installed immediately shall be stored in a cool and dark place.



## 1.6 UTILITY PROTECTION

- A. Forty-eight (48) hours prior to excavation, the Contractor shall call the appropriate Utilities Protection Center to locate and protect existing utilities. Any damage to these utilities is to be repaired at no additional cost to NFCU. The Contractor is responsible for locating all utilities, either private or public.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. All piping, valves and appurtenances shall be of the same size shown on the drawings and as far as possible all equipment of the same type shall be from one manufacturer.
- B. All piping, valves and appurtenances shall have the name of the maker and the working pressure for which they are designed cast in raised letters upon some appropriate part of the body.
- C. All buried valves shall have cast iron three piece valve boxes unless specified otherwise by the authority with jurisdiction. Valve boxes shall be provided with suitable heavy bonnets and to extend to such elevation at or slightly above the finished grade. The barrel shall be two-piece, sliding type, having 5-1/4 inch shaft. The upper section shall have a flange at the bottom having sufficient bearing area to prevent settling.

### 2.2 PIPE

- A. Pipe sizes less than 3 inches that are installed below grade and outside buildings shall comply with one or a combination of following:
  - 1. Polyvinyl Chloride (PVC) Water Pipe: Pipe shall conform to ASTM D 2241 with an SDR 21 rating and shall be continually marked with manufacturer's name, pipe size, cell classification, SDR rating, and ASTM D 1785 classification. Pipe joints shall be integrally molded bell ends in accordance with ASTM D 3139 with factory supplied elastomeric gaskets and lubricant.
  - 2. Other pipe material as specified by the authority with jurisdiction.
- B. Pipe sizes 3 inches and larger that are installed below grade and outside buildings shall comply with the following:

Polyvinyl Chloride (PVC) Water Pipe: Pipe shall meet the requirements of AWWA C-900 and comply with ASTM D 2241, rated SDR 21 (Class 150). Pipe shall be continually marked as for smaller pipes. Pipe joints shall be integrally molded bell ends in accordance with ASTM D 3139, Table 2, with factory supplied elastomeric gaskets and lubricant.

### 2.3 GATE VALVES - 2 Inches and Larger

- A. Manufacturers: Per Local Municipal Standards.
- B. Gate valves for water shall meet the requirements of AWWA C509. Valve shall be rated for 250 psi working pressure. Valves shall be iron body, bronze-mounted, resilient wedge, parallel seat, non-rising stem type fitted with "O-Ring" seals. The operating nuts shall be 2" square. All valves shall open left, or counterclockwise. Stuffing boxed shall be the "O-Ring" type. Gate valves shall be mechanical joint, ANSI Standard 21.11 except where shown otherwise. Flange joint shall be ANSI B16.1 standard. Bell joint shall be AWWA Class 150.

2.4 BALL VALVES - 2 Inches and Smaller

- A. Manufacturers: Per Local Municipal Standards.
- B. Brass body, Teflon coated brass ball, rubber seats and stem seals, Tee stem pre-drilled for control rod, AWWA compression inlet end, compression outlet with electrical ground connector, with control rod, extension box and valve key.

2.5 BUTTERFLY VALVES - 2 inches to 24 inches

- A. Manufacturers: Per Local Municipal Standards.
- B. AWWA C504, iron body, bronze disc, resilient replaceable seat, water or lug ends, infinite position lever handle.

2.6 CHECK VALVES, POST INDICATOR VALVES, AND BACKFLOW PREVENTORS

- A. See also - Fire Suppression elsewhere in Division 13.
- B. Post Indicator Valves shall be a below grade visual type per Local Municipal Standards.

2.7 HYDRANTS

- A. Hydrant: Type as required by utility company, local authority having jurisdiction and as indicated on Drawings.
- B. Hydrant Extensions: Provide in multiples of 6 inches with rod and coupling to increase barrel length.
- C. Hose and Stream Connection: Match sizes with utility company, two hose nozzles, one pumper nozzle.
- D. Finish: Primer and two coats of enamel or special coating to color as required by utility company.

2.8 ACCESSORIES

- A. Concrete for Thrust Blocks: Elsewhere in Division 3. Place thrust blocking consisting of 3,000 psi concrete to provide sufficient bearing area to transmit unbalanced thrust from bends, tees, caps, or plugs to undisturbed soil without loading undisturbed soil in excess of 2,500 pounds per square foot when water main pressure is 100 psi.

MINIMUM THRUST BLOCKING BEARING AREAS

Pipe Diameter	Tees Sq. Ft.	90° Bend Sq. Ft.	45° Bend Sq. Ft.	22° Bend Sq. Ft.	11° Bend Sq. Ft.
3"	1.0	1.0	1.0	1.0	1.0
4"	1.0	1.0	1.0	1.0	1.0
6"	1.5	2.0	1.0	1.0	1.0
8"	2.5	3.5	1.8	1.0	1.0
10"	4.0	5.5	2.8	1.5	1.0
12"	6.0	8.0	4.0	2.0	1.5
14"	8.0	11.0	5.5	3.0	2.0
16"	10.0	14.2	7.0	4.0	3.0
18"	21.0	21.0	12.0	6.0	4.0

- B. Locked Mechanical Joint fittings shall be installed where vertical changes in direction are required and, if approved by the authority with jurisdiction, can be installed in lieu of the above thrust blocking requirements.
- C. Trace Wire: Magnetic detectable conductor, clear brightly colored plastic covered, imprinted in large letters.
  - 1. Domestic Water Lines: "DOMESTIC WATER SERVICE"
  - 2. Fire Protection Water Lines: "FIRE PROTECTION WATER SERVICE"
- D. Insulating Joints: Joints between pipes of dissimilar metals shall have a rubber-gasketed or other suitable approved type of insulating joint or dielectric coupling which will effectively prevent metal-to-metal contact between adjacent sections of piping.
- E. Reinforcing Steel; Deformed bars, ASTM A615.

### **PART 3 - EXECUTION**

#### **3.1 GENERAL**

- A. Excavation and backfilling as specified elsewhere in Division 2.
  - 1. Trench width (measured at 2 feet above top of pipe).
    - a. Not less than 12 inches, not more than 16 inches plus outside diameter of pipe, up to 33-inch diameter pipe.
    - b. 24 inches plus outside diameter of pipe, for pipes greater than 33 inches.
- B. Existing underground utilities which are to be abandoned are to be capped off and are to remain in place. Where they are within the new building area or come in conflict with new construction, they shall be completely removed.

#### **3.2 BEDDING**

- A. Bedding shall be of the type and thickness shown on the drawings.
- B. Excavate pipe trench and place bedding material in accordance with Excavation and Fill elsewhere in Division 2 for work of this Section. Provide trench wall shoring as required.
- C. Form and place concrete for pipe thrust restraints at any change of pipe direction and at fittings as indicated on Drawings. Place concrete to permit full access to pipe and pipe accessories. Provide thrust restraint bearing on subsoil per schedule on Drawings.
- D. Place bedding material at trench bottom, level fill materials in one continuous layer not exceeding 6 inches compacted depth, each layer. Place compacted bedding material to elevation of paving subgrade as indicated on Drawings.
- E. Maintain optimum moisture content of bedding material to attain required compaction density.
- F. Remove excess backfill and excavated material from site.

#### **3.3 INSTALLATION - PIPE AND FITTINGS**

- A. Maintain separation of water main from sanitary and storm sewer piping in accordance with state or local code.

- B. Install pipe and fittings in accordance with AWWA C600.
- C. Install pipe to allow for expansion and contraction without stressing pipe or joints or as specified by pipe manufacturer.
- D. Install access fittings in accordance with local codes to permit disinfection of water system performed under this Section.
- E. Connections with Existing Pipelines: Where connections are made between new work and existing piping, make connection using suitable fittings for conditions encountered. Make each connection with existing pipe at time and under conditions which least interfere with operation of existing pipeline and in compliance with the local utility company.
- F. Form and place concrete for thrust blocks or other specified methods of retainage at each change of direction or end of pipe main.
- G. Establish elevations of buried piping in accordance with Excavation and Fill elsewhere in Division 2 for work in this Section.
- H. Backfill trench in accordance with Excavation and Fill elsewhere in Division 2.
- I. Install trace wire continuous buried 10 inches below finish grade, above pipe line. Trace wire shall be in accordance with local utility standards.

#### 3.4 INSTALLATION - VALVES AND HYDRANTS

- A. Install gate valves as indicated on Drawings and supported on concrete pads with valve stem vertical and plumb. Install valve boxes in a manner that will not transmit loads, stress, or shock to valve body. Center the valve box over the operating nut of valve vertical and plumb. Securely fit valve box together leaving cover flush with finished surface.
- B. Install fire hydrant assemblies as indicated on Drawings in vertical and plum position with stream/pumper nozzle pointed perpendicular to traffic where hydrant is adjacent to a street, roadway or parking lot drive or toward the protected building unless otherwise directed by local authorities. Support hydrant assembly on concrete pad and firmly braced on side opposite inlet pipe against undisturbed soil and concrete blocking. Place minimum of 6 cu. ft. of crushed stone or gravel around hydrant base and barrel after thrust blocking has cured at least 24 hours. Exercise care when backfilling and compacting so proper vertical position will not be altered.
- C. Provide a drainage pit 36 inches square by 24 inches deep filled with 2 inch washed gravel. Encase elbow of hydrant in gravel to 6 inches above drain opening. Do not connect drain opening to sewer.
- D. Paint hydrants in accordance with local utility company requirements.

#### 3.5 SHOP PAINTING

- A. Paint used for coating valves shall comply with the following Fed. Spec. TT-V-51, TT-C-494a, AWWA C-550. The asphalt varnish shall be applied to the ferrous parts of the valves except for finished or seating surfaces. Surfaces shall be clean and dry before painting. Two coats shall be applied to both the inside and outside ferrous metals. A coating conforming to AWWA C-550 may be used on the interior and/or exterior ferrous surfaces.

#### 3.6 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Disinfect distribution system with chlorine before acceptance for domestic operation. Amount of chlorine shall be such as to provide dosage of not less than 50 parts/million. Thoroughly flush lines before introduction of chlorinating materials and after contact period of not less than 24 hours, system shall be flushed with clean water until residual chlorine content is not greater than 1.0 part/million. Open and close valves in lines being disinfected several times during contact period. After disinfection, take water sample and bacteriological test in accordance with AWWA specifications. Do not place distribution system in service until approval is obtained from applicable governing authorities.

### 3.7 INSPECTION AND TESTING

- A. Completed pipe shall be subjected to hydrostatic pressure test for 12 hours at full working pressure. All leaks shall be repaired and lines re-tested. Prior to testing, pipelines shall be supported in an approved manner to prevent movement during tests.
- B. Water Lines:
  - 1. Pressure Test: After joints complete and partial backfill subject to pressure 50% in excess of operating pressure. Test per AWWA C600.
  - 2. Leakage Test: AWWA C600
  - 3. Certificate of Compliance: Each shipment of materials.

### 3.8 SERVICE CONNECTIONS

- A. Provide water service connection in compliance with utility company requirements including reduced pressure backflow preventer if required and water meter with by-pass valves and sand strainer.

**End of Section 331100**

## SECTION 333000 - SANITARY SEWERS

### PART 1 - GENERAL

#### 1.1 SCOPE OF WORK

- A. The Contractor shall provide all labor, materials, equipment and incidentals necessary for the installation of the sanitary sewer system. Including but not limited to manholes, pipes, joints, valves and other appurtenances necessary for a complete system.
- B. The construction required herein shall include constructing sewers to points of connection with the building drains 5 feet outside the building to which the sewer system is to be connected. The Contractor shall replace damaged material and redo unacceptable work at no additional cost to Navy Federal Credit Union (NFCU). Excavation and backfilling is specified in Section 31 23 00.00 20 - EXCAVATION, FILLING, AND BACKFILLING FOR BUILDINGS AND UTILITY SYSTEMS. Backfilling shall be accomplished after inspection by the Geotechnical Engineer. Force mains and inverted siphons, if required, are specified elsewhere. The Contractor shall have a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the Engineer.
- C. The Contractor shall provide barricades, warning signs, and warning lights around open excavations as necessary to prevent injury to persons.
- D. The Contractor is solely responsible for determining the potential for injury to persons and damage to property. Where such potential is present, the contractor shall take appropriate measures to protect persons from injury and protect existing and new improvements from damage caused directly or indirectly by construction operations.

#### 1.2 REFERENCE DOCUMENTS

- A. City of Westworth Village, Texas Water Department Standards and Specifications.
- B. American Society for Testing and Materials
  - 1. ASTM C 33 2007 Concrete Aggregates
  - 2. ASTM C 94 2007 Ready-Mixed Concrete
  - 3. ASTM C 144 2004 Standard Specification for Aggregate for Masonry Mortar
  - 4. ASTM C 150 2007 Portland Cement
  - 5. ASTM C 270 2007a Mortar for Unit Masonry
  - 6. ASTM C 443 2005a Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
  - 7. ASTM C 478 2008 Precast Reinforced Concrete Manhole Sections
  - 8. ASTM D 412 2006a Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
  - 9. ASTM D 1784 2007 Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
  - 10. ASTM D 3034 2006 Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
  - 11. ASTM D 3212 2007 Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
  - 12. ASTM F 402 2005 Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
  - 13. ASTM F 477 2007 Elastomeric Seals (Gaskets) for Joining Plastic Pipe
  - 14. ASTM F 794 2003 Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings

- Based on Controlled Inside Diameter
15. ASTM F 949 2006a Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

C. Uni-Bell PVC Pipe Association

1. UBPPA UNI-B-6 - (1990) Recommended Practice for the Low-Pressure Air Testing of Installed Sewer Pipe
2. UBPPA UNI-B-9 - (1990; Addenda 1994) Recommended Performance Specification for Polyvinyl Chloride (PVC) Profile Wall Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter (Nominal Pipe Sizes 4-48 inch)

D. National Fire Protection Association

1. NFPA 49(1994) Hazardous Chemicals Data
2. NFPA 325-1(1994) Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids
3. NFPA 704(1996) Identification of the Fire Hazards of Materials for Emergency Response

### 1.3 SUBMITTALS

Comply with the applicable provisions of Section 01 33 00 Site Work Submittals.

- A. Submit, within thirty (30) days after execution of the contract, the manufacturer's certificate of compliance or certified analysis in accordance with applicable standards for each shipment of materials.
- B. Samples of the products used.
- C. Complete shop drawings of all pipes, valves, structures and appurtenances shall be submitted for review.
- D. Submit As-Builts for all components of the sanitary sewer distribution system, such as pipes, cleanouts, and structures.

### 1.4 QUALITY ASSURANCE

- A. All appurtenances shall be the products of firms fully experienced and qualified in the manufacturing of the particular material to be furnished.
- B. All additional temporary piping, pumps, and equipment necessary for the successful testing of the system is to be provided by the Contractor.
- C. All materials to meet the requirements of the governing authority.

### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris.
- B. Before, during, and after installation, pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material.
- C. The Contractor shall have a copy of the manufacturer's instructions available at the construction site at

all times and shall follow these instructions unless directed otherwise by the Engineer.

- D. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install pipe shall be stored in accordance with the manufacturer's recommendations and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.
- E. Materials shall be handled in a manner that ensures delivery to the trench in sound, undamaged condition. Pipe shall be carried to the trench, not dragged. Any damaged items shall be replaced at no additional cost to NFCU.

## 1.6 UTILITY PROTECTION

Forty-eight (48) hours prior to excavation, the Contractor shall call the appropriate Utilities Protection Center to locate and protect existing utilities. Any damage to these utilities is to be repaired at no additional cost to NFCU. The Contractor is responsible for locating all utilities, either private or public.

## PART 2 - PRODUCTS

### 2.1 PIPE

- A. All gravity sanitary sewer shall be as shown on the drawings. The materials shall be as specified herein and in accordance with the referenced documents.
- B. Polyvinyl Chloride (PVC) Pipe
  - 1. ASTM D 3034, Type PSM with a maximum SDR of 26, Size 15 inches or less in diameter.
  - 2. ASTM F 949 for corrugated sewer pipes with a smooth interior.
  - 3. UBPPA UNI-B-9 and ASTM F 794, Series 46, for ribbed sewer pipe with smooth interior, size 8 inch through 48 inch diameters.
  - 4. All PVC shall be certified by the compounder as meeting the requirements of ASTM D 1784, cell Class 12454B. The pipe stiffness shall be greater than or equal to  $735/D$  for cohesionless material pipe trench backfills.
  - 5. Standard pipe lengths not greater than twenty feet shall be used on all work.

### 2.2 FITTINGS

- A. Fittings shall be compatible with the pipe supplied and shall have a strength not less than that of the pipe. Fittings shall conform to the respective specifications and other requirements specified below.
- B. Polyvinyl Chloride (PVC) Pipe
  - 1. ASTM D 3034 for type PSM pipe.
  - 2. ASTM F 949 for corrugated sewer pipe with a smooth interior.
  - 3. UBPPA UNI-B-9 and ASTM F 794, Series 46, for ribbed sewer pipe with smooth interior.

### 2.3 JOINTS

- A. Joint installation shall comply with the manufacturer's instructions. Fittings and gaskets utilized for waste drains or industrial waste lines shall be certified by the manufacturer as oil resistant.
- B. Polyvinyl Chloride (PVC) Pipe

PVC gasketed joints shall conform to ASTM D 3212.



## 2.4 BRANCH CONNECTIONS

Branch connections shall be made by use of wye fittings. Tees and saddles shall not be used unless permitted by the local governing authority and then shall comply with the standards of the local governing authority. The Contractor shall obtain the approval of the Engineer prior to using tees or saddles.

## 2.5 FRAMES AND COVERS

Frames and covers shall be as indicated on the Drawings and shall comply with the standards of the local governing authority.

## 2.6 ACCESS STEPS AND SAFETY PLATFORMS

Access steps and safety platforms shall be as indicated on the Drawings and shall comply with the standards of the local governing authority.

## 2.7 CEMENT MORTAR

- A. Cement mortar shall conform to ASTM C 270, Type M with Type II cement.
- B. Portland cement shall conform to ASTM C 150, Type II for concrete used in manholes and type optional with the Contractor for cement used in concrete cradle, concrete encasement, and thrust blocking. Where aggregates are alkali reactive, as determined by Appendix XI of ASTM C 33, cement containing less than 0.60 percent alkalis shall be used.
- C. Portland cement concrete shall conform to ASTM C 94, compressive strength of 4000 psi at 28 days, except for concrete cradle and encasement or concrete blocks for manholes. Concrete used for cradle and encasement shall have a compressive strength of 3000 psi minimum at 28 days. Concrete in place shall be protected from freezing and moisture loss for a minimum of 7 days.

## 2.8 PRECAST REINFORCED CONCRETE STRUCTURES

- A. Precast concrete manholes shall consist of precast reinforced concrete sections with eccentric, (or flat slab for shallow manholes) top section and a base section conforming with the typical manhole details as shown on the drawings.
- B. Precast reinforced concrete manhole sections shall be manufactured, tested, and marked in accordance with the latest provisions of ASTM C478.
- C. Joints of manhole sections shall be of the tongue-and-groove type. Sections shall be joined using O-ring rubber gaskets, flexible plastic gaskets conforming to the applicable provisions of ASTM C443, latest revision, or an approved bituminous mastic joint material.
- D. Each section of the precast manhole shall have not more than two holes for the purpose of handling and laying. These holes shall be sealed with cement mortar using one part Portland cement to two parts clean sand, meeting ASTM C144, latest revision. Holes shall be sealed from the outside prior to backfilling the manhole.
- E. Holes in precast bases to receive sewer pipe shall be precast at the factory at the required locations and heights. Knocking out of holes in the field will not be permitted. All manholes shall have Kor-N-Seal (or equal) rubber boots for all pipe entries/exits.

- F. Manhole bases and inverts shall be constructed of 4000 psi concrete in accordance with details on the drawings and inverts shall have the same cross-section as the invert of the sewers that they connect.
- G. Each manhole base shall be set upon a 6 inch minimum thickness mat of #57 crushed stone.

### PART 3 - EXECUTION

#### 3.1 GENERAL

##### A. Separation of Water Mains and Sewers

###### 1. Parallel Installation:

- a. Normal conditions – sanitary sewer lines shall be laid at least 10 feet horizontally from water lines, storm sewer lines, or sewer manholes. The distance is to be measured from edge-to-edge.
- b. Unusual conditions - when local conditions prevent horizontal separation of 10 feet, the sanitary sewer line may be laid closer to water lines and storm sewers provided that:
  - (1) Bottom of water main is at least 18 inches above top of sewer.
  - (2) Where 18 inch vertical separation cannot be obtained, sanitary sewer shall be encased in 6" of concrete around pipe. The concrete encasement is to run the full length that the 10-foot separation is not furnished.
  - (3) Where 18 inch vertical separation cannot be obtained and concrete encasement is not allowed, sanitary sewer shall be installed in a steel sleeve. The sleeve is to run the full length that the 10-foot separation is not furnished.

###### 2. Crossings:

- a. Normal conditions – sanitary sewers crossing water lines or storm sewers shall be laid to provide a separation of at least 18 inches between bottom of water main and top of sewer, whenever possible.
- b. Unusual conditions - when local conditions prevent a vertical separation as described in 3.1.A.1.b.1, sanitary sewers passing over or under water mains shall be constructed as described in 3.1.A.1.b.2. Concrete encasement is to extend 10' on both sides of crossing.
- c. Unusual conditions - when local conditions prevent a vertical separation as described in 3.1.A.1.b.1 and concrete encasement is not allowed, sanitary sewers passing over or under water mains shall be constructed as described in 3.1.A.1.b.3. Steel sleeve is to extend 10' on both sides of crossing.

##### B. Road crossings shall be as shown on the Drawings.

##### C. Where sewer pipe is to be installed within 3 feet of an existing or proposed building or structural foundation such as a retaining wall or any similar structure, the sewer pipe shall be protected as shown on the Drawings. Contractor shall ensure there is no damage to these structures, and that there is no settlement or movement of foundations or footings.

#### 3.2 PIPE INSTALLATION

##### A. Pipe Laying

- 1. Pipe shall be protected during handling against impact shocks and free fall; the pipe interior shall be free of extraneous material.
- 2. Pipe laying shall proceed upgrade with the spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow. Each pipe shall be laid accurately to

- the line and grade shown on the drawings. Pipe shall be laid and centered so that the sewer has a uniform invert. As the work progresses, the interior of the sewer shall be cleared of all superfluous materials.
3. Before making pipe joints, all surfaces of the portions of the pipe to be joined shall be clean and dry. Lubricants, primers, and adhesives shall be used as recommended by the pipe manufacturer. The joints shall then be placed, fitted, joined, and adjusted to obtain the degree of water tightness required.
  4. Shape bottom of trench by hand for circumferential support to bottom 1/4 of pipe.
- B. Trenches shall be kept free of water and as dry as possible during bedding, laying, and jointing and for as long a period as required. When work is not in progress, open ends of pipe and fittings shall be satisfactorily closed so that no trench water or other material will enter the pipe or fittings.
  - C. As soon as possible after the joint is made, sufficient backfill material shall be placed along the pipe to prevent pipe movement off line or grade. Plastic pipe shall be completely covered to prevent damage from ultraviolet light.
  - D. If the maximum width of the trench at the top of the pipe, as specified in Section 31 23 00.00 20 - EXCAVATION, FILLING, AND BACKFILLING FOR BUILDINGS AND UTILITY SYSTEMS, is exceeded for any reason other than by direction, the Contractor shall install, at no additional cost to NFCU, concrete cradling, pipe encasement, or other bedding required to support the added load of the backfill.
  - E. Joints between different pipe materials shall be made as specified, using approved jointing materials.
  - F. Pipe, fittings and joint material shall be handled and stored in accordance with the manufacturer's recommendations. Storage facilities for plastic pipe, fittings, joint materials and solvents shall be classified and marked in accordance with NFPA 704, with classification as indicated in NFPA 49 and NFPA 325-1.

### 3.3 TESTING AND INSPECTION

- A. All testing shall be in accordance with the governing authority having jurisdiction. Where these specifications conflict with the standards and specifications of the governing authority having jurisdiction, the more conservative requirement(s) shall be implemented.
- B. Leakage Tests
  1. Lines shall be tested for leakage by low pressure air testing, infiltration tests or exfiltration tests, as appropriate.
  2. Low pressure air testing for PVC pipe shall be as prescribed in UBPPA UNI-B-6.
  3. Low pressure air testing for DIP shall be as required by the governing authority having jurisdiction.
  4. Prior to infiltration or exfiltration tests, the trench shall be backfilled up to at least the lower half of the pipe. If required, sufficient additional backfill shall be placed to prevent pipe movement during testing, leaving the joints uncovered to permit inspection.
  5. Visible leaks encountered shall be corrected regardless of leakage test results. When the water table is 2 feet or more above the top of the pipe at the upper end of the pipeline section to be tested, infiltration shall be measured using a suitable weir or other device acceptable to the local governing authority.
  6. When the local governing authority determines that infiltration cannot be properly tested, an exfiltration test shall be made by filling the line to be tested with water so that a head of at least 2 feet is provided above both the water table and the top of the pipe at the upper end of the pipeline to be tested. The filled line shall be allowed to stand until the pipe has reached

its maximum absorption, but not less than 4 hours. After absorption, the head shall be re-established. The amount of water required to maintain this water level during a 2-hour test period shall be measured.

7. Leakage as measured by either the infiltration test or exfiltration test shall not exceed 0.2 gal per inch diameter per 100 feet of pipeline per hour. When leakage exceeds the maximum amount specified, satisfactory correction shall be made and retesting accomplished. Testing, correction, and retesting shall be made at no additional cost to NFCU.

- C. Deflection Tests: All PVC pipe must pass a 5.0% deflection test as follows: Not before 30 days after pipe is laid and backfill placed, the Contractor shall, in the presence of the Inspector, test the pipe for deflection. A mandrel, sized to permit up to 5.0% deflection, shall be used. The sequence for testing is as follows:

1. Completely flush the line making sure the pipe is clean of any mud or debris that would hinder the passage of the mandrel.
2. During the final flushing of the line, attach a floating block or ball to the end of the mandrel pull rope and float the rope through the line.
3. After the rope is threaded through the line, connect the pull rope to the mandrel and place the mandrel in the entrance of the pipe.
4. Connect a retrieval rope to the back of the mandrel to pull it back, if necessary.
5. Remove all the slack in the pull rope and place a tape marker on the rope at the ends of the pipe where the mandrel will exit, determining the location of the mandrel in the line.
6. Draw mandrel through the sewer line.
7. If a section with excessive deflection is found, locate it; dig down and uncover the pipe; inspect the pipe, if any damaged pipe is found, replace it; if pipe is not damaged, replace and thoroughly tamp the haunching and initial backfill and replace remainder of backfill.

#### 3.4 CONCRETE CRADLE AND ENCASEMENT

- A. Pipe shall be supported on a concrete cradle or encased in concrete where indicated on the Drawings or as required by on-site conditions.

#### 3.5 INSTALLATION OF WYE BRANCHES

- A. Wye branches shall be installed where sewer connections are indicated on the Drawings.
- B. Cutting into piping for connections shall not be done except in special approved cases.
- C. When the connecting pipe cannot be adequately supported on undisturbed earth or tamped backfill, the pipe shall be encased in concrete backfill or supported on a concrete cradle as directed. Concrete required because of conditions resulting from faulty construction methods or negligence by the Contractor shall be installed at no additional cost to NFCU.
- D. The installation of wye branches in an existing sewer shall be made in accordance with the standards and specifications of the governing authority having jurisdiction.

#### 3.6 MANHOLE INSTALLATION

- A. Manholes shall be constructed of precast concrete manhole sections.
- B. Invert channels shall be smooth and semicircular in shape conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large a radius as the size of the manhole will permit. Changes in size and grade of the channels shall be made gradually and evenly.

The invert channels shall be formed directly in the concrete of the manhole base, or shall be built up with brick and mortar.

- C. Pipe connections shall be made to manhole as shown on the Drawings.
- D. The floor of the manhole outside the channels shall be smooth and shall slope toward the channels not less than 1 inch per foot nor more than 2 inches per foot.
- E. Free drop inside the manholes shall not exceed 18 inches, measured from the invert of the inlet pipe to the top of the floor of the manhole outside the channels; drop manholes shall be constructed whenever the free drop would otherwise be greater than 18 inches.
- F. Manhole access steps shall be installed as shown on the Drawings.
- G. Mastic joints between precast rings shall be full-bedded in jointing compound and shall be smoothed to a uniform surface on both the interior and exterior of the manhole. Installation of rubber gasket joints between precast rings shall be in accordance with the recommendations of the manufacturer.
- H. Unless otherwise indicated, tops of frames and covers shall be set flush with finished grade in paved areas or 6 inches higher than finished grade in unpaved areas. Frame and cover assemblies shall be sealed to manhole sections using external preformed rubber joint seals that meet the requirements of ASTM D 412 and ASTM D 624 unless otherwise specified.

### 3.7 CONNECTING TO EXISTING MANHOLES

- A. Pipe connections to existing manholes shall be made so that finish work will conform as nearly as practicable to the applicable requirements specified for new manholes, including all necessary concrete work, cutting, and shaping.
- B. The connection shall be centered on the manhole.
- C. Holes for the new pipe shall be of sufficient diameter to allow packing cement mortar around the entire periphery of the pipe but no larger than 1.5 times the diameter of the pipe.
- D. Cutting the manhole shall be done in a manner that will cause the least damage to the walls.

### 3.8 BUILDING CONNECTIONS

- A. Building connections shall include the lines to and connection with the building waste drainage piping at a point approximately 5 feet outside the building, unless otherwise indicated.
- B. Where building drain piping is not installed, the Contractor shall terminate the building connections approximately 5 feet from the site of the building at a point and in a manner designated on the Drawings.

### 3.9 PIPE PLUGS

- A. Wye branches: Manufactured stopper installed in accordance with provisions for jointing.
- B. Sewer Pipe: Manufactured stopper or concrete masonry minimum 4 inches thick.
- C. Plugs shall permanently seal pipe but must be able to be removed without damaging the pipe.

### 3.10 CLEANOUTS AND OTHER APPURTENANCES

Cleanouts and other appurtenances shall be installed where shown on the Drawings or as directed by the Inspector, and shall conform to the detail on the Drawings.

**End of Section 333000**

## SECTION 334000 - STORM DRAINAGE SYSTEM

### PART 1 - GENERAL

#### 1.1 SCOPE OF WORK

- A. The Contractor shall provide all labor, materials, equipment and incidentals necessary for the installation of the storm sewer system. Including but not limited to manholes, pipes, joints, and other appurtenances necessary for a complete system.
- B. The construction required herein shall include construction storm sewers to points of connection with the building drains 5 feet outside the building to which the storm system is to be connected. The Contractor shall replace damaged material and redo unacceptable work at no additional cost to Navy Federal Credit Union (NFCU). Excavation and backfilling is specified in Section 312300.00 20 - EXCAVATION, FILLING, AND BACKFILLING FOR BUILDINGS AND UTILITY SYSTEMS. Backfilling shall be accomplished after inspection by the Geotechnical Engineer. The Contractor shall have a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the Engineer.
- C. The Contractor shall provide barricades, warning signs, and warning lights around open excavations as necessary to prevent injury to persons.
- D. The Contractor is solely responsible for determining the potential for injury to persons and damage to property. Where such potential is present, the contractor shall take appropriate measures to protect persons from injury and protect existing and new improvements from damage caused directly or indirectly by construction operations.

#### 1.2 REFERENCE DOCUMENTS

- A. City of Westworth Village, Texas Stormwater Utility
- B. American Society for Testing and Materials
  - 1. ASTM C 32 2005 Sewer and Manhole Brick (Made from Clay or Shale)
  - 2. ASTM C 22/C 2000(2005)e1 Standard Specification for Concrete Aggregates
  - 3. ASTM C 55 2006e1 Concrete Brick
  - 4. ASTM C 62 2005 Building Brick (Solid Masonry Units Made from Clay or Shale)
  - 5. ASTM C 76 2008 Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
  - 6. ASTM C 94 2007 Standard Specification for Ready-Mixed Concrete
  - 7. ASTM C 139 2005 Concrete Masonry Units for Construction of Catch Basins and Manholes
  - 8. ASTM C 144 2004 Standard Specification for Aggregate for Masonry Mortar
  - 9. ASTM C 150 2007 Standard Specification for Portland Cement
  - 10. ASTM C 270 2007a Mortar for Unit Masonry
  - 11. ASTM D 412 2006a Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension
  - 12. ASTM C 443 2005a Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
  - 13. ASTM C 478 2008 Precast Reinforced Concrete Manhole Sections
  - 14. ASTM D 624 2000(2007) Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
  - 15. ASTM D 1056 2007 Flexible Cellular Materials - Sponge or Expanded Rubber
  - 16. ASTM D 11711999(2007) Rubber Deterioration - Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens)

17. ASTM D 1784 2007 Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
18. ASTM D 2321 2005 Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
19. ASTM D 3034 2006 Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
20. ASTM D 3350 2006 Polyethylene Plastics Pipe and Fittings Materials
21. ASTM F 477 2007 Elastomeric Seals (Gaskets) for Joining Plastic Pipe
22. ASTM F 679 2008 Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings

### 1.3 SUBMITTALS

Comply with the applicable provisions of Section 013400 Site Work Submittals.

- A. Submit, within thirty (30) days after execution of the contract, the manufacturer's certificate of compliance or certified analysis in accordance with applicable standards for each shipment of materials. All certificates shall not be older than one year.
- B. Submit As-Builts for all components of the storm water drainage system such as pipes and structures.
- C. Printed copies of the manufacturer's recommendations for installation procedures of the material being placed, prior to installation.
- D. Complete shop drawings of all pipes, valves, structures and appurtenances shall be submitted for review.
- E. Project Record Documents: Accurately record the following.
  1. Actual locations of pipe runs, connections, manholes, catch basins, cleanouts, and invert elevations.
  2. Identify and describe unexpected variations to subsoil conditions and location of uncharted utilities.

### 1.4 QUALITY ASSURANCE

- A. All appurtenances shall be the products of firms fully experienced and qualified in the manufacturing of the particular material to be furnished.
- B. All additional temporary piping, pumps, and equipment necessary for the successful testing of the system is to be provided by the Contractor.
- C. All materials to meet the requirements of the governing authority.
- D. In addition to regular maintenance the contractor shall clear all storm drainage structures and pipe of all dirt, debris, and garbage at the completion of construction.

### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris.
- B. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment



that would result in damage or deterioration to the material.

- C. The Contractor shall have a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the Engineer.
- D. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install plastic pipe shall be stored in accordance with the manufacturer's recommendations and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.
- E. Materials shall be handled in a manner that ensures delivery to the trench in sound, undamaged condition. Pipe shall be carried to the trench, not dragged.

## 1.6 UTILITY PROTECTION

Forty-eight (48) hours prior to excavation, the Contractor shall call appropriate Utilities Protection Center to locate and protect existing utilities. Any damage to these utilities is to be repaired at no additional cost to NFCU. The Contractor is responsible for locating all utilities, either private or public.

## PART 2 - PRODUCTS

### 2.1 PIPE FOR CULVERTS AND STORM DRAINS

- A. All storm sewer shall be as shown on the drawings. The materials shall be as specified herein and in accordance with the referenced documents.
- B. Reinforced Concrete Pipe shall conform to ASTM C 76, Class III for all pipe 42 inches and smaller and Class IV for all pipe 48 inches and larger unless indicated otherwise on the Drawings. Gaskets shall conform to ASTM C 443; rubber compression gaskets installed in accordance with manufacturer's published instructions.
- C. PVC Pipe shall be smooth wall conforming to ASTM F 679 produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B. Joints shall comply with ASTM D 3034, Table 2; integrally molded bell ends with factory supplied elastomeric gaskets and lubricant.

### 2.2 FITTINGS

- A. Fittings shall be compatible with the pipe supplied and shall have a strength not less than that of the pipe. Fittings shall conform to the respective specifications and other requirements specified below.
- B. Reinforced Concrete Pipe shall have rubber-type gaskets conforming to ASTM C 443. Gaskets shall have not more than one factory-fabricated splice, except that two factory-fabricated splices of the rubber-type gasket are permitted if the nominal diameter of the pipe being gasketed exceeds 54 inches.
- C. Polyvinyl Chloride (PVC) Pipe: Joints shall be solvent cement or elastomeric gasket type in accordance with the specification for the pipe and as recommended by the pipe manufacturer.

### 2.3 FRAMES, COVERS, AND GRATES

Frames, covers, and gates shall be as indicated on the Drawings and shall comply with the standards of the local governing authority.

### 2.4 ACCESS STEPS AND SAFETY PLATFORMS

Access steps and safety platforms shall be as indicated on the Drawings and shall comply with the standards of the local governing authority.

## 2.5 CEMENT MORTAR

- A. Cement mortar shall conform to ASTM C 270, Type M with Type II cement.
- B. Portland cement shall conform to ASTM C 150, Type II for concrete used in manholes, concrete cradles, concrete encasement, and thrust blocking. Where aggregates are alkali reactive, as determined by Appendix XI of ASTM C 33, a cement containing less than 0.60 percent alkalis shall be used.
- C. Portland cement concrete shall conform to ASTM C 94, compressive strength of 4000 psi at 28 days, except for concrete cradle and encasement or concrete blocks for manholes. Concrete used for cradle and encasement shall have a compressive strength of 3000 psi minimum at 28 days. Concrete in place shall be protected from freezing and moisture loss for a minimum of 7 days.

## 2.6 CONCRETE

Unless otherwise specified, concrete and reinforced concrete shall conform to the requirements for concrete specified elsewhere in division three.

## 2.7 PRECAST CONCRETE SEGMENTAL BLOCKS

Precast concrete segmental block shall conform to ASTM C 139, not more than 8 inches thick, not less than 8 inches long, and of such shape that joints can be sealed effectively and bonded with cement mortar.

## 2.8 BRICK

- A. Brick shall conform to ASTM C 62, Grade SW; ASTM C 55, Grade S-I or S-II; or ASTM C 32, Grade MS.
- B. Mortar for jointing and plastering shall consist of one part Portland cement and two parts fine sand. Lime may be added to the mortar in a quantity not more than 25 percent of the volume of cement. The joints shall be filled completely and shall be smooth and free from surplus mortar on the inside of the structure.
- C. Brick structures shall be plastered with 1/2 inch of mortar over the entire inside surface of the walls.
- D. For square or rectangular structures, brick shall be laid in stretcher courses with a header course every sixth course.
- E. For round structures, brick shall be laid radially with every sixth course a stretcher course.

## 2.9 PRECAST REINFORCED CONCRETE STRUCTURES

- A. Precast concrete structures shall consist of precast reinforced concrete sections conforming with the typical details as shown on the drawings.
- B. Precast reinforced concrete manhole sections shall be manufactured, tested, and marked in accordance with the latest provisions of ASTM C478.
- C. Joints of manhole sections shall be of the tongue-and-groove type. Sections shall be joined using O-ring rubber gaskets, flexible plastic gaskets conforming to the applicable provisions of ASTM C443 or an approved bituminous mastic joint material.

- D. Each section of the precast manhole shall have not more than two holes for the purpose of handling and laying. These holes shall be sealed with cement mortar using one part Portland cement to two parts clean sand, meeting ASTM C144. Holes shall be sealed from the outside prior to backfilling the manhole.
- E. Holes in precast bases to receive sewer pipe shall be precast at the factory at the required locations and heights. Knocking out of holes in the field will not be permitted.
- F. Manhole bases and inverts shall be constructed of 4000 psi concrete in accordance with details on the drawings and inverts shall have the same cross-section as the invert of the sewers that they connect.
- G. Each manhole base shall be set upon a 6 inch minimum thickness mat of #57 crushed stone.

### **PART 3 - EXECUTION**

#### **3.1 EXCAVATION FOR PIPE CULVERTS, STORM DRAINS, AND DRAINAGE STRUCTURES**

Excavation of trenches, and for appurtenances and backfilling for culverts and storm drains, shall be in accordance with the applicable portions of Section 31 23 00.00 20 - EXCAVATION, FILLING, AND BACKFILLING FOR BUILDINGS AND UTILITY SYSTEMS

#### **3.2 BEDDING**

- A. Bedding shall be of the type and thickness shown on the drawings.
- B. The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe.
- C. Concrete Pipe Bedding: When no bedding class is specified or detailed on the drawings, concrete pipe shall be bedded in a soil foundation accurately shaped and rounded to conform to the lowest one-fourth of the outside portion of the pipe for the entire length of the pipe. When necessary, the bedding shall be tamped. Bell holes and depressions for joints shall be not more than the length, depth, and width required for properly making the particular type of joint.
- D. Corrugated Metal Pipe Bedding: Bedding for corrugated metal pipe and pipe arch shall be in accordance with ASTM A 798. It is not required to shape the bedding to the pipe geometry.
- E. Ductile Iron Pipe Bedding: Bedding for ductile iron pipe shall be as shown on the drawings.
- F. Plastic Pipe Bedding: Bedding for PVC and PE pipe shall meet the requirements of ASTM D 2321. Bedding, haunching, and initial backfill shall be either Class IB or II material.

#### **3.3 PIPE INSTALLATION**

- A. Pipe Laying
  - 1. Pipe shall be protected during handling against impact shocks and free fall; the pipe interior shall be free of extraneous material. Each pipe shall be thoroughly examined before being laid; defective or damaged pipe shall not be used. Plastic pipe shall be protected from exposure to direct sunlight prior to laying, if necessary to maintain adequate pipe stiffness and meet installation deflection requirements.
  - 2. Pipe laying shall proceed upgrade with the spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow. Each pipe shall be laid accurately to the line and grade shown on the drawings. Pipe shall be laid and centered so that the sewer has a uniform invert. As the work progresses, the interior of the sewer shall be cleared of all

- superfluous materials.
3. Before making pipe joints, all surfaces of the portions of the pipe to be joined shall be clean and dry. Lubricants, primers, and adhesives shall be used as recommended by the pipe manufacturer. The joints shall then be placed, fitted, joined, and adjusted to obtain the degree of water tightness required.
  4. Shape bottom of trench by hand for circumferential support to bottom 1/4 of pipe.
  5. Pipe shall not be laid in water, and pipe shall not be laid when trench conditions or weather are unsuitable for such work.
- B. Trenches shall be kept free of water and as dry as possible during bedding, laying, and jointing and for as long a period as required. When work is not in progress, open ends of pipe and fittings shall be satisfactorily closed so that no trench water or other material will enter the pipe or fittings.
- C. As soon as possible after the joint is made, sufficient backfill material shall be placed along the pipe to prevent pipe movement off line or grade. Plastic pipe shall be completely covered to prevent damage from ultraviolet light.
- D. If the maximum width of the trench at the top of the pipe, as specified in Section 31 23 00.00 20 - EXCAVATION, FILLING, AND BACKFILLING FOR BUILDINGS AND UTILITY SYSTEMS, is exceeded for any reason other than by direction, the Contractor shall install, at no additional cost to NFCU, concrete cradling, pipe encasement, or other bedding required to support the added load of the backfill.
- E. Joints between different pipe materials shall be made as specified, using approved jointing materials.
- F. Multiple Culverts: Where multiple lines of pipe are installed, adjacent sides of pipe shall be at least half the nominal pipe diameter or 3 feet apart, whichever is less.

### 3.4 JOINTING

#### Reinforced Concrete Pipe:

1. Gaskets and jointing materials shall be as recommended by the particular manufacturer in regard to use of lubricants, cements, adhesives, and other special installation requirements.
2. Surfaces to receive lubricants, cements, or adhesives shall be clean and dry.
3. Gaskets and jointing materials shall be affixed to the pipe not more than 24 hours prior to the installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times.
4. Gaskets and jointing materials shall be inspected before installing the pipe; any loose or improperly affixed gaskets and jointing materials shall be removed and replaced.
5. The pipe shall be aligned with the previously installed pipe, and the joint pushed home. If, while the joint is being made the gasket becomes visibly dislocated the pipe shall be removed and the joint remade.

### 3.5 BACKFILLING AND COMPACTION

- A. Backfilling and compaction for culverts and storm drains shall be in accordance with the applicable portions of Section 31 23 00.00 20 - EXCAVATION, FILLING, AND BACKFILLING FOR BUILDINGS AND UTILITY SYSTEMS.
- B. When compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over a culvert or storm drain at any stage of construction shall be at the Contractor's risk. Any damaged pipe shall be repaired or replaced at no additional cost to NFCU.

### 3.6 CONCRETE CRADLE AND ENCASEMENT

Pipe shall be supported on a concrete cradle or encased in concrete where indicated on the Drawings or as required by on-site conditions.

### 3.7 INSTALLATION OF STORM DRAINAGE STRUCTURES AND HEADWALLS

- A. Structures shall be constructed of precast concrete.
- B. Invert channels shall be smooth and semicircular in shape conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large a radius as the size of the manhole will permit. Changes in size and grade of the channels shall be made gradually and evenly. The invert channels shall be formed directly in the concrete of the manhole base, or shall be built up with brick and mortar.
- C. Pipe connections shall be made to manhole as shown on the Drawings.
- D. The floor of the manhole outside the channels shall be smooth and shall slope toward the channels not less than 1 inch per foot nor more than 2 inches per foot.
- E. Free drop inside the manholes shall not exceed two times the diameter of the largest pipe, measured from the invert of the inlet pipe to the top of the floor of the manhole outside the channels; drop manholes shall be constructed whenever the free drop would otherwise be greater than two times the diameter of the largest pipe.
- F. Manhole access steps shall be installed as shown on the Drawings.
- G. Mastic joints between precast rings shall be full-bedded in jointing compound and shall be smoothed to a uniform surface on both the interior and exterior of the manhole. Installation of rubber gasket joints between precast rings shall be in accordance with the recommendations of the manufacturer.
- H. Unless otherwise indicated, tops of frames and covers shall be set flush with finished grade in paved areas or 6 inches higher than finished grade in unpaved areas. Frame and cover assemblies shall be sealed to manhole sections using external preformed rubber joint seals that meet the requirements of ASTM D 412 and ASTM D 624 unless otherwise specified.

### 3.8 CONNECTING TO EXISTING MANHOLES

- A. Pipe connections to existing manholes shall be made so that finish work will conform as nearly as practicable to the applicable requirements specified for new manholes, including all necessary concrete work, cutting, and shaping.
- B. The connection shall be centered on the manhole.
- C. Holes for the new pipe shall be of sufficient diameter to allow packing cement mortar around the entire periphery of the pipe but no larger than 1.5 times the diameter of the pipe.
- D. Cutting the manhole shall be done in a manner that will cause the least damage to the walls.

### 3.9 BUILDING CONNECTIONS

- A. Building connections shall include the lines to and connection with the building drainage piping at a point approximately 5 feet outside the building, unless otherwise indicated.
- B. Where building drain piping is not installed, the Contractor shall terminate the building connections approximately 5 feet from the site of the building at a point and in a manner designated on the Drawings.

### 3.10 CLEANOUTS AND OTHER APPURTENANCES

Cleanouts and other appurtenances shall be installed where shown on the Drawings or as directed by the Inspector, and shall conform to the detail on the Drawings.

### 3.11 TESTING AND INSPECTION

Leakage and deflection testing shall be performed in accordance with the requirements of the governing authority having jurisdiction.

**End of Section 334000**