

# PROJECT MANUAL

## S-29 MILLER ARMORY LATRINE ADDITION CAMP DODGE, JOHNSTON, IOWA

Project No. 19083730  
Contract No. C32998060

JULY 25, 2024

**SHIVEHATTERY**  
ARCHITECTURE + ENGINEERING

SH Project No.: 211220964-0



IOWA ARMY NATIONAL GUARD

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# PROJECT MANUAL

## S-29 MILLER ARMORY LATRINE ADDITION CAMP DODGE, JOHNSTON, IOWA

For The  
**IOWA ARMY NATIONAL GUARD**

Project No. 19083730  
Contract No. C32998060

**JULY 25, 2024**

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*THE ARMORY BOARD  
DEPARTMENT OF PUBLIC DEFENSE (MILITARY DIVISION)*

*THE ADJUTANT GENERAL  
Major General STEPHEN E. OSBORN  
CHAIRMAN OF THE ARMORY BOARD*

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**ISSUED BY:**

**STATE COMPTROLLER OFFICE:**

Zach Gillen, Contracting Officer  
Camp Dodge, Building 3465 (W-41)  
7105 NW 70th Avenue  
Johnston, IA 50131-1824  
Phone: (515) 252-4522

**CONSTRUCTION & FACILITIES MANAGEMENT OFFICE:**

Michael Brothers, Design Branch Chief  
Camp Dodge, Building 3535 (B-61)  
7105 NW 70th Avenue  
Johnston, IA 50131-1824  
Phone: (515) 252-4225

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DOCUMENT 00 01 02

PROJECT DESIGN TEAM:

**ARCHITECT:**

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Shive-Hattery  
4125 Westown Parkway, Suite 100  
West Des Moines, Iowa 50266  
515-223-8104 (phone)  
[mkleene@shive-hattery.com](mailto:mkleene@shive-hattery.com) (email)

**GEOTECHNICAL ENGINEER:**

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DOCUMENT 00 01 05

CERTIFICATIONS

|                                                                                               |                                                                                                                                                                                                     |
|-----------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                               | I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa. |
|                                                                                               | _____                                                                                                                                                                                               |
|                                                                                               | <b>Signature</b> <span style="float: right;"><b>Date</b></span>                                                                                                                                     |
|                                                                                               | Printed or typed name: Michael J. Kleene                                                                                                                                                            |
|                                                                                               | License Number: 06502                                                                                                                                                                               |
|                                                                                               | My license renewal date is: 06-30-2026                                                                                                                                                              |
| Pages, Sheets, or Divisions covered by this Seal:<br>Divisions 00, 02, 04, 06, 07, 08, 09, 10 |                                                                                                                                                                                                     |

|                                                                          |                                                                                                                                                                                                     |
|--------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                          | I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa. |
|                                                                          | _____                                                                                                                                                                                               |
|                                                                          | <b>Signature</b> <span style="float: right;"><b>Date</b></span>                                                                                                                                     |
|                                                                          | Printed or typed name: Evan M. Timm                                                                                                                                                                 |
|                                                                          | License Number: 26626                                                                                                                                                                               |
|                                                                          | My license renewal date is: 12-31-2024                                                                                                                                                              |
| Pages, Sheets, or Divisions covered by this Seal:<br>Divisions 03 and 05 |                                                                                                                                                                                                     |

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <p>I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.</p> <p>_____</p> <p><b>Signature</b> <span style="float: right;"><b>Date</b></span></p> <p>Printed or typed name: Travis L. Sprenger</p> <p>License Number: 24039</p> <p>My license renewal date is: 12-31-2024</p> <p>Pages, Sheets, or Divisions covered by this Seal:<br/>Divisions 22 and 23</p> |
|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <p>I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.</p> <p>_____</p> <p><b>Signature</b> <span style="float: right;"><b>Date</b></span></p> <p>Printed or typed name: Kevin J. Bruxvoort</p> <p>License Number: 19927</p> <p>My license renewal date is: 12-31-2025</p> <p>Pages, Sheets, or Divisions covered by this Seal:<br/>Divisions 26, 27, and 28</p> |
|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <p>I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.</p> <p>_____</p> <p><b>Signature</b> <span style="float: right;"><b>Date</b></span></p> <p>Printed or typed name: Kaitlin R. Wilkerson</p> <p>License Number: 26418</p> <p>My license renewal date is: 12-31-2024</p> <p>Pages, Sheets, or Divisions covered by this Seal:<br/>Division 31, 32, and 33</p> |
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END OF DOCUMENT 00 01 05



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**Responsible  
Party****Number Title**

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| IAARNG | Document | 00 01 02 | Project Design Team |
| SH     | Document | 00 01 05 | Certifications      |
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## BIDDING REQUIREMENTS

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| IAARNG | Document | 00 21 00    | Instructions to Bidders                                  |
| SH     | Document | 00 31 00    | Geotechnical Exploration Report                          |
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| IAARNG | Document | 00 43 14.13 | Supplement B.1 - Communications Schedule of Values       |
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| IAARNG | Document | 00 43 25    | Supplement F - Substitution Request Form (Bidding Phase) |
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**Legend:**

IAARNG: Iowa Army National Guard  
SH: Shive-Hattery, Inc.

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### **Legend:**

IAARNG: Iowa Army National Guard  
SH: Shive-Hattery, Inc.

## DIVISION 22 - PLUMBING

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### Legend:

IAARNG: Iowa Army National Guard  
SH: Shive-Hattery, Inc.

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\*Denotes specification sections covered by the 2024 Edition of the Iowa Statewide Urban Design and Specifications (SUDAS) excluding the measurement and payment sections. Local jurisdictional and utility provider requirements and specifications shall apply and take precedent. The 2024 SUDAS Manual can be found at the below link:

<https://www.iowasudas.org/manuals/specifications-manual/>

END OF DOCUMENT 00 01 10

### **Legend:**

IAARNG: Iowa Army National Guard  
SH: Shive-Hattery, Inc.

ADVERTISEMENT FOR BIDS

**PROJECT TITLE:** S-29 MILLER ARMORY LATRINE ADDITION  
**BID DATE:** AUGUST 22, 2024  
**PROJECT LOCATION:** CAMP DODGE, JOHNSTON, IOWA  
**PROJECT NO.:** 19083730  
**CONTRACT NO.:** C32998060

The Iowa Department of Public Defense, on behalf of the Iowa National Guard (IANG), will be receiving sealed bids until **1:00 P.M.** local time in the west conference room of **BUILDING 3535 (B-61), CAMP DODGE**, 7105 NW 70<sup>TH</sup> AVENUE, JOHNSTON, IOWA 50131-1824 for the proposed S-29 MILLER ARMORY LATRINE ADDITION, CAMP DODGE, JOHNSTON, IOWA. The general scope of work includes, but is not limited to:

**Base Bid:** A latrine addition to the north side of S-29 Miller Armory including associated site improvements. Latrine spaces to include both women's and men's bathroom, shower, and accessory areas as well as associated mechanical, electrical, and plumbing improvements to facilitate the latrine spaces. Project also includes primarily interior renovations to convert existing locker room space partially into new JNN lab space, located in the NW corner of the S-29 Miller Armory facility. These renovations include new wall and interior finishes to support the JNN lab space.

**Alternate Bid No.1:** Removal of external sanitary sewer routing and connection scope with internal sewage ejector pump/pit and associated internal pipe routing to connect to existing sanitary sewer piping within existing S-29 Miller Armory.

Bids received will be opened and read aloud at the time and place stated. Late bids will not be considered. Bids must be hand-delivered (bids received via mail, delivery service, oral, telephonic, facsimile or other electronically transmitted bids will not be accepted). Interested parties are invited to attend.

Bids shall be submitted on the Bid Form and shall be accompanied by a Bid Security as set forth in the Instructions to Bidders in the amount of five percent (5%) of the total bid amount. Each bid shall be accompanied by a bid bond executed by corporations authorized to contract as surety in Iowa, cashier's check or a certified check drawn upon a solvent bank chartered under the laws of the United States of America, made payable to Iowa Department of Public Defense; as a guarantee that the accepted bidder shall enter into a contract with the State of Iowa and file an approved surety company Performance and Payment Bond for the faithful performance thereof. Upon failure to comply, said check or bid bond shall become forfeited as liquidated damages.

Any construction contractor performing work in Iowa (including out-of-state contractors) must comply with Chapter 91C of Iowa Code

Bidders must comply with all affirmative action/equal employment opportunity provisions of the State of Iowa and the Federal Government. The Iowa Department of Public Defense, Iowa Army National Guard, seeks to provide opportunities for Targeted Small Businesses in accordance with the provisions of Chapter 73 of the Code of Iowa. A listing of certified Targeted Small Businesses can be obtained by visiting the Iowa Department of Economic Development website at <https://iowaeda.microsoftcrmpartals.com/tsb-search/>

The Iowa Department of Public Defense reserves the right to reject any and all bids, and to waive irregularities and to accept a bid that is deemed in the best interest of the State of Iowa and the IANG.

This project is exempt from Iowa Sales Tax. Davis Bacon Wages **will not** apply to this project.

Bidding Documents may be obtained from Beeline and Blue (2507 Ingersoll Avenue, Des Moines, Iowa 50312, (515) 244-1611 or 1-800-347-1610) and will be loaned to qualified contract bidders upon receipt of Master Builders of Iowa non-cash deposit card or a check in the amount of fifty dollars (\$50.00) deposit per set payable to "Iowa Department of Public Defense". Deposit will be refunded to bidders upon return of their complete set of Bidding Documents, including any addenda, properly bound and in good condition to Beeline and Blue within 14 calendar days after opening of bids. Cash deposits will not be accepted.

Bidding Documents may also be viewed online or downloaded at [www.beelineandblue.com](http://www.beelineandblue.com). Click on "EPLANROOM" and then "PUBLIC JOBS". Register and log in, then select the project name or enter the project name in the search window.

The Plan Holders List may be viewed online at [www.beelineandblue.com](http://www.beelineandblue.com). Navigate to the project as outlined above and click on the "PLAN HOLDERS" tab.

For questions regarding the website, please call (515) 244-1611 or 1-800-347-1610.

A set of the Bidding Documents is also available for review at the Construction and Facilities Management Office, Bldg 3535 (B-61), Camp Dodge.

Award of this contract is dependent on receiving requested Federal and/or State funding. If such funding is not received within the sixty (60) day bid guarantee after the date of receiving bids, all rights and obligations under this agreement are considered null and void.

A Pre-Bid Conference will be held at **10:00 A.M.** local time, **THURSDAY, AUGUST 8, 2024** in the west conference room of **BUILDING 3535 (B-61) Camp Dodge**, 7105 NW 70<sup>th</sup> Avenue, Johnston, Iowa to review the Plans and Project Manual and to answer questions on this project. All interested parties are invited to attend.

For further information regarding this project please call Michael Brothers at (515) 252-4225 or Zach Gillen at (515) 252-4522.

END OF DOCUMENT 00 11 00

DOCUMENT 00 21 00  
INSTRUCTIONS TO BIDDERS

**TABLE OF ARTICLES**

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2. RECEIPT AND OPENING OF BIDS
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## ARTICLE 1 - DEFINITIONS

- 1.1** The following definitions add to the list of definitions included in the General Conditions of the Contract and shall be used in conjunction with them as a part of the Bidding Documents.
- 1.2** Bidding Documents include The Bidding Requirements and the proposed Contract Documents:
- 1.3** The Bidding Requirements consists of:
- .1 Advertisement For Bids.
  - .2 Instructions to Bidders.
  - .3 Form of Bid
  - .4 Supplements to Form of Bid:
    - .(1) Supplement A: Bid Bond..... (Submit With Form of Bid)
    - .(2) Supplement B.1: Communications Schedule of Values.
    - .(3) Supplement D: Targeted Small Business Form..... (Submit With Form of Bid)
    - .(4) Supplement F: Substitution Request Form (Bidding Phase).
    - .(5) Supplement G: Proposed Subcontractor Form.
    - .(6) Supplement H: Wage Rate Requirements Statement
    - .(7) Supplement J: 889 Representation Form
- 1.4** The Proposed Contract Documents consists of:
- .1 Form of Agreement between the Owner and Contractor.
  - .2 Conditions of the Contract (General, Supplementary, and other Conditions).
  - .3 Drawings.
  - .4 Specifications.
  - .5 Addenda issued prior to execution of the Contract.
  - .6 Modifications issued after execution of the Contract.
  - .7 Other documents listed in the Agreement.
- 1.5** Definitions set forth in the General Conditions of the Contract for Construction or in other Contract Documents are applicable to the Bidding Documents.
- 1.6** Addenda are a written or graphic instruments issued by the Architect prior to the execution of the Contract which modify or interpret the Bidding Documents by additions, deletions, clarifications, or corrections.
- 1.7** A Bid is a complete and properly executed proposal to do the Work for the sums stipulated therein, submitted in accordance with the Bidding Documents.
- 1.8** The Base Bid is the sum stated in the Bid for which the Bidder offers to perform the Work as described in the Bidding Documents.
- 1.9** An Allowance is a specified monetary sum, specified quantity or time not otherwise defined by the specifications or drawings, but which the contractor is required to include in the bid price.
- 1.10** A Unit Price is an amount stated in the Bid as a price per unit of measurement for materials, equipment or services or a portion of the Work as described in the Bidding Documents.
- 1.11** An Alternate Bid (or Alternate) is an amount stated in the Bid to be added to or deducted from the amount of the Base Bid if the corresponding change in the Work, as described in the Bidding Documents, is accepted.
- 1.12** A Bidder is a person or entity who submits a Bid and who meets the requirements set forth in the Bidding Documents.
- 1.13** A Sub-bidder is a person or entity who submits a Bid to a Bidder for materials, equipment or labor for a portion of the Work.



## ARTICLE 2 - RECEIPT AND OPENING OF BIDS

- 2.1 The Iowa Department of Public Defense (Military Division), Iowa Army National Guard, hereinafter called the Owner, will receive Bids in the west conference room of Building **3535 (B-61)**, Camp Dodge, 7105 NW 70<sup>th</sup> Avenue, Johnston, Iowa 50131-1824, until the established bid date and time (see Section 00 41 00 - Form of Bid). The Owner will then publicly open and read all properly submitted Bids.
- 2.2 The Owner will secure, unopened, all Bids received prior to the established bid date and time. The Owner's representative whose duty it is to open Bids will decide when the specified time has arrived and will not consider any Bid received thereafter.
- 2.3 The Owner will reject and return unopened any Bid received after the time specified for the receipt of Bids.
- 2.4 **Oral, telephonic, telegraphic, facsimile or other electronically transmitted bids will not be considered.**
- 2.5 **Mailed or Delivery Service Bids will not be considered.**
- 2.6 Each Bidder shall be solely responsible for the delivery of their Bid to the Owner at the place and before the time specified in Paragraph 2.1 above.
- 2.7 Photo identification will be required to gain entrance at the front gate of Camp Dodge.
- 2.8 The Owner acknowledges the responsibility of the Iowa Public Bidding Requirements in advertising and receiving bids for this project.

## ARTICLE 3 - BIDDING DOCUMENTS

- 3.1 Bidders may obtain complete sets of the Bidding Documents from the issuing entity designated in the Advertisement for Bid for the deposit sums stated therein. Deposits will be refunded as designated in the Advertisement for Bid.
- 3.2 Bidders and Sub-bidders shall use complete sets of Bidding Documents in preparing Bids; neither the Owner nor Architect assumes responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.
- 3.3 The Owner and Architect may make copies of the Bidding Documents available on the above terms for the Purpose of obtaining Bids on the Work. No license or grant of use is conferred by issuance of copies of the Bidding Documents.

## ARTICLE 4 - PREPARATION OF BIDS

- 4.1 Prepare Bids on an exact copy of the "Form of Bid" included in these documents. Fill in all applicable blank spaces, typewritten or in ink. The amount must be in both words and figures. If words and figures do not agree, the amount as written in words shall govern.
- 4.2 All requested Alternates shall be bid. If no change in the Base Bid is required, enter "No Change".
- 4.3 The person signing the Bid must initial all erasures or corrections.
- 4.4 Bids must indicate the full name of the Bidder, must be signed in the firm or corporate name of the Bidder, and must bear the longhand signature of a principal duly authorized to execute contracts for the Bidder. Bids signed by an agent of the Bidder must be accompanied by evidence of the agent's authority to execute contracts for the Bidder. Type or print below the signature the name of each person signing the Bid.

## ARTICLE 5 - SUBMITTAL OF BIDS

- 5.1 Enclose in its own sealed envelope the “Form of Bid for Construction Contract” separate from the other required Supplements to the Form of Bid identified below and label with the name of the Bidder and the following designation:

**SEALED BID for:  
S-29 MILLER ARMORY LATRINE ADDITION  
CAMP DODGE, JOHNSTON, IOWA  
Contract Number C32998060  
Iowa Army National Guard**

- 5.2 Enclose in a second sealed envelope along with the separately sealed “Form of Bid for Construction Contract” the following Supplements to the Form of Bid:

1. Supplement A: The Bid Security (Contractor provided document).
2. Supplement D: Targeted Small Business Form (use provided form).

Label this second sealed envelope with the name and address of the Bidder and the following designation:

**BID DOCUMENTS for:  
S-29 MILLER ARMORY LATRINE ADDITION  
CAMP DODGE, JOHNSTON, IOWA  
Contract Number C32998060  
Iowa Army National Guard**

- 5.3 **HAND CARRIED BIDS:** Deliver to address indicated in Article 2.1 above.

## ARTICLE 6 - MODIFICATION OF BIDS

- 6.1 No modification of submitted Bids in any way or form will be permitted.

## ARTICLE 7 - WITHDRAWAL OF BIDS

- 7.2 Any Bid may be withdrawn and resubmitted prior to the time set for the receipt of Bids provided that they are then fully in conformance with these Instructions to Bidders. Bid security shall be in an amount sufficient for the Bid as resubmitted.

- 7.3 No bid may be withdrawn for a period of sixty (60) calendar days after the time set for the receipt of Bids.

## ARTICLE 8 - IOWA TARGETED SMALL BUSINESS REQUIREMENTS

- 8.1 PROGRAM DESCRIPTION AND REQUIREMENTS:

- 8.1.1 On construction contracts bid competitively for which a participation goal is indicated, each Bidder who is not a Targeted Small Business and who will be using a Certified Targeted Small Business Subcontractor or supplier must:

- .1 Submit with the Form of Bid: Supplement D: Targeted Small Business Form provided herein.
- .2 Comply with all relevant provisions of the Iowa Civil Rights Act, Chapter 601A; Executive Order #11, 1984, and #15, 1973, as appended by Executive Order #34, dated July 22, 1988; Federal Executive Order #11245, 1965, as amended by Federal Executive Order #11375, 1967; the Equal Employment Opportunity Act of 1972; and Iowa Code Section 19B.7.
- .3 Comply with all provisions of the State of Iowa relevant to fair employment practices, and furnish all information and submit all reports requested by these provisions.

- .4 Continue to use the Iowa Targeted Small Business certification guidelines as set out in 481-Chapter 25 of the Iowa Administrative Code for the purpose of identifying Targeted Small Businesses for participation in the award of general and subcontracts.
- 8.1.2** The mandatory set-aside requirements and bid preferences required by Iowa Code Sections 73.16 to 73.21 are not currently in effect. Use the following guidelines to encourage Targeted Small Business participation.
- 8.1.3** DEFINITIONS:
- .1 Actively manage means exercising the power to make policy decisions affecting the business.
  - .2 Minority person means an individual who is black, Hispanic, Pacific Island native, American Indian, or Alaskan Native.
  - .3 Operated means actively involved in the day-to-day management of the business.
  - .4 Small Business means any enterprise which is located in this State, which is operated for profit under a single management, and which has either fewer than twenty employees or an annual gross income of less than three million dollars computed as an average of the three previous years.
- 8.2** The Department of Public Defense (Military Division), Iowa Army National Guard (IAARNG), seeks to provide opportunities for Targeted Small Businesses in the awarding of contracts. The IAARNG may award contracts to Targeted Small Businesses under the terms of the Iowa Small Business Procurement Act of 1986 and the Iowa Administrative Code. The IAARNG is also authorized to establish certified Targeted Small Business participation requirements for construction contracts.
- 8.3** When entering into this contract with the IAARNG, the General Contractor will take documented steps to encourage participation from Targeted Small Businesses for the purpose of subcontracting or supplying of materials. This project has a Targeted Small Business participation goal of ten percent (10%).
- 8.4** If a prime contractor fails to meet the Targeted Small Business participation goal indicated, the prime contractor shall still be required to submit with the Form of Bid (on the Targeted Small Business Form provided herein) the names of Targeted Small Businesses contacted.
- 8.5** If the Bidder intends to subcontract with a certified Targeted Small Business in the absence of a stated Targeted Small Business participation goal, the Bidder should inform the State Comptroller Office of this intent by submitting a Targeted Small Business Form so that they may receive credit for this participation.

## **ARTICLE 9 - BID SECURITY FOR TARGETED SMALL BUSINESS BIDDERS**

- 9.1** On projects where Bid amount exceeds \$25,000.00, the instructions in Article 10, Bid Security for Non-Targeted Small Business Bidders, apply.
- 9.2** On Bids of \$25,000.00 or less, Certified Targeted Small Businesses, as part of the Bid Documents, may either provide a Bid Bond or a bond waiver from the Department of Economic Development.

## **ARTICLE 10 - BID SECURITY FOR NON-TARGETED SMALL BUSINESS BIDDERS**

- 10.1** Secure Bids with a cashier's check, certified check, or a Bid Bond in an amount of at least five percent (5%) of the Bid. The Owner will automatically disqualify Bids secured by other means.
- 10.2** Make certified checks and cashier's checks payable to "IOWA DEPARTMENT OF PUBLIC DEFENSE".

- 10.3** Submit Bid Bonds in the form prescribed in these documents. Bid Bonds must be executed solely by corporations authorized to contract a surety in Iowa and, in addition to all other provisions, clearly designate an Iowa resident agent as attorney-in-fact. Attorneys-in-fact who sign surety bonds must file with each bond a certified and effectively dated copy of their power of attorney.
- 10.4** Bid security acts as the measure of liquidated damages which the Owner will sustain by failure, neglect, or refusal of Bidder to deliver a signed contract stipulating performance of the Work in unqualified compliance with Contract Documents within ten (10) days after notification of award of contract is given.
- 10.5** The Owner will return Bid security when submitted in the form of either a cashier's check or a certified check by any Bidder except the three lowest Bidders within forty-eight (48) hours after opening.
- 10.6** The Owner will all return retained Bid securities (cashier's check, or certified check) within forty-eight (48) hours of executing a contract, performance and payment bond with the successful Bidder. If the award process involves more than the bid holding time established in the Bidding Documents, those Bidders whose securities are retained shall have the right to negotiate with the Owner on the matter.

#### **ARTICLE 11 - QUALIFICATION OF BIDDERS**

- 11.1** Bidders must be registered with the Iowa Labor Commissioner. The Bidders must include an Iowa registration number as provided for on the Form of Bid.
- 11.2** Non-resident corporations submitting Bids must be in compliance with Section 490.1501 of the Code of Iowa and legally authorized thereby to carry on such business in the State of Iowa as is required by the Contract Documents.
- 11.3** Non-resident corporations certify by submittal of a Bid that the corporation shall comply with Chapter 73 of the Iowa Code.
- 11.4** The Owner may make such investigations as deemed necessary to determine the ability of the Bidder to perform the Work, and the Bidder must furnish to the Owner all such information and data for these purposes as the Owner may request. The Owner reserves the right to reject any Bid if the evidence submitted by, or investigation of, such Bidder fails to satisfy the Owner that such Bidder is properly qualified to carry out the obligations of the Contract and to complete the Work described herein.
- 11.5** The Owner gives preference to Iowa domestic labor in the constructing or building of any public improvement. By virtue of statutory authority, preference is given to products and provisions produced or grown within the State of Iowa.
- 11.6** Bidders and all Subcontractors shall be prepared to represent post-bid whether they do or do not use prohibited telecommunications equipment or services in accordance with Section 889 Part B of the FY 2019 National Defense Authorization Act (NDAA). Refer to Article 22 – Post-Bid Information

#### **ARTICLE 12 - SUBCONTRACTORS**

- 12.1** In accordance with Iowa law, the successful Bidder must furnish in writing to the Owner a list of the names of subcontractors who will work on the project as described in Article 22.
- 12.2** The Bidder is specifically advised that any person, firm, or other party to whom it is proposed to award a subcontract under this Contract must (1) be registered in the State of Iowa and have contractor's registration number, and (2) be acceptable to the Owner.

## ARTICLE 13 - BIDDERS REPRESENTATION

- 13.1** Each Bidder by submitting a Bid represents that:
- 13.1.1** The Bidder has read and completely understands the Bidding Requirements and Contract Documents.
  - 13.1.2** The Bidder has visited the site, become familiar with the local conditions under which the Work is to be performed, including availability and cost of labor and materials, and has carefully correlated personal observations with the requirements of the Contract Documents.
    - .1** A tour of the site will be conducted following the Pre-Bid Conference identified in the Advertisement for Bids. Bidders shall arrange for other site visits in advance by contacting **Brenda Wilder at (515) 252-4370**.
  - 13.1.3** The Bid is based upon the materials, equipment and systems required by the Bidding Documents without exception.
  - 13.1.4** The Bidder has familiarized himself/herself with Federal, State, and Local laws, ordinances, rules, and regulations affecting performance of the Work.
  - 13.1.5** The Bidder agrees that the Contract Time will begin upon receipt of a Notice to Proceed from the Owner, and will achieve Substantial Completion of all the Work within the Contract Time stated on the Bid Form, excepting for delays covered in Article 8 of the General Conditions of the Contract.
  - 13.1.6** The Bidder has given preference to use of Iowa domestic labor and products and provisions produced or grown within the State of Iowa.
- 13.2** Failure of the selected Bidder to fulfill the provisions of this Article in no way relieve the obligation of the Bidder to furnish all materials and labor necessary to carry out the provisions of the Contract, nor shall such failure constitute grounds for extra compensation over the price stated in the accepted Bid.

## ARTICLE 14 - SUBSTITUTIONS

- 14.1** The materials, products and equipment described in the Bidding Documents establish a standard of required function, dimension, appearance, and quality to be met by any proposed substitution.
- 14.2** No substitution will be considered during the bidding period unless written request has been submitted to the Architect for approval, on the form provided herein, at least 5 days prior to the bid date. Each such request must include the name of the material, product or equipment for which it is to be substituted and a complete description of the proposed substitution including drawings, cuts, performance and test data, and any other data or information necessary for a complete evaluation. The burden of proof of the merit of the proposed substitution is upon the proposer.
- 14.3** Request for approval of a substitution will not be considered if Substitution Request Form provided herein is not completely filled out.
- 14.4** If the Architect approves any proposed substitution, such approval is not official until set forth in an addendum. Do not include any substitutions not confirmed by written addenda.
- 14.5** Substitutions after the Contract Award may be considered only as provided for in the Conditions of the Contract and Division 1 of the Project Manual.

## **ARTICLE 15 - ADDENDA AND INTERPRETATIONS**

- 15.1** Bidders must carefully examine and compare the Bidding Documents, examine the site and local conditions and at once report any ambiguity, inconsistency, or error discovered. Bidders and Sub-bidders requiring clarification or interpretation of the Bidding Documents shall make written request to the Architect for interpretation or correction. Such requests must reach the Architect at least seven (7) days prior to the bid date.
- 15.2** The Architect will issue any and all interpretations, corrections, revisions, and amendments to all holders of Bidding Documents in the form of written addenda. Addenda will be transmitted at least forty-eight (48) hours prior to the time set for the receipt of Bids to all who are known by the issuing office to have received a complete set of Bidding Documents. Copies of Addenda will be made available for inspection wherever Bidding Documents are on file for that purpose. Each Bidder is responsible to ascertain prior to submitting a Bid that the Bidder has received all Addenda issued. All addenda issued shall become part of the Contract Documents and Bidders must acknowledge them in the Form of Bid.
- 15.3** Only those interpretations, corrections, revisions, and amendments confirmed by written addenda are binding. Bidders are cautioned to refrain from including in their Bid any interpretations, corrections, revisions, or amendments which are not confirmed by written addenda.
- 15.4** Any question relating to the technical specifications may be directed to the individuals identified on Document 00 01 02 – Project Design Team.

## **ARTICLE 16 - BID PREFERENCE**

- 16.1** All Bidders must certify their state or foreign country of residence by completing the official address section of the Form of Bid.
- 16.2** Under Iowa law, as described in the Iowa Administrative Code, resident Bidders on public improvements are allowed a preference equal to the preference given or required by the state or foreign country in which the nonresident Bidder is a resident. "Resident Bidder" means a person or firm authorized to transact business in this State, and having a place of business at which it is and has conducted business for at least six months prior to the first advertisement for the public improvement and, in the case of a corporation, at least fifty percent (50%) of the common stock is owned by residents of this State.

## **ARTICLE 17 - METHOD OF AWARD**

- 17.1** It is the intent of the Owner to award a Contract to the lowest qualified Bidder provided the Bid has been submitted in accordance with the requirements of the Bidding Documents and does not exceed the funds available. The Owner may reject any or all Bids, waive any irregularities, informalities, or technicalities in any Bid, and accept any Bid in whole or in part which it deems to be in the Owner's best interests.
- 17.2** All requested Alternates shall be bid. The Owner reserves the right to accept Alternates in any order or combination, and to determine the low Bidder on the basis of the sum of the Base Bid and Alternate(s) accepted.
- 17.3** Generally, all Bids received by the Owner which require allocation of appropriated Government funding are subject to the acceptance of the issuing department for the State of Iowa. Each prime Bidder, subcontractor, and material supplier on this project agrees to guarantee their Bid for a period of sixty (60) calendar days after the time set for the receipt of Bids.
- 17.4** Award of this contract is dependent on receiving requested Federal and/or State funding. If such funding is not received within the sixty (60) day Bid guarantee after the date of receiving Bids, all rights and obligations to enter into a contract are considered null and void.

- 17.5 The Owner sending a "Notice of Award" to the selected Bidder constitutes award of the Contract.

#### **ARTICLE 18 - EXECUTION OF CONTRACT**

- 18.1 Selected Bidder must, within ten (10) calendar days after receiving Notice of Award, enter into a written contract with the Owner on the Form of Agreement prescribed in these documents.
- 18.2 The Contract, when duly executed, represents the entire agreement between parties.
- 18.3 Simultaneously with the delivery of the executed Contract, the Contractor must furnish a performance and payment surety bond in the amount of 100% of the Contract Sum as security for faithful performance of the Contract and for the payment of all persons performing labor and furnishing materials for the work, or evidence of eligibility for waiver of the bond requirements. The bond shall be on the form prescribed in these documents (Submit one copy only). The surety on such bond shall be by a corporation duly authorized to do business in the State of Iowa, and said bond shall be signed or countersigned by an Iowa Resident Agent. Attorneys-in-fact who sign surety bonds must file with each bond a certified and effectively dated copy of their power of attorney.
- 18.4 Completed Contract and Contract Performance and Payment Bond must be dated the same and executed as per State contracting instruction procedures.
- 18.5 The Owner will maintain a contract administration system ensuring that contractors perform in accordance with the terms, conditions, and specification of their Contract Document.

#### **ARTICLE 19 - IOWA STATE BUILDING CODE**

- 19.1 All construction under this Contract must conform to the requirements of the Iowa State Building Code. Adhere to the provisions of the Iowa State Building Code which takes precedence over local governmental bodies' regulations. Perform work not regulated by the Iowa State Building Code in accordance with other applicable local regulations.

#### **ARTICLE 20 - TAXES**

- 20.1 This project is TAX EXEMPT. Refer to Article 3.6 of the General Conditions (as modified by the Supplementary Conditions) and Article 22.4 of the Instructions To Bidders.

#### **ARTICLE 21 - PREBID CONFERENCE**

- 21.1 The Owner requests Bidders to attend a pre-bid conference on the date, time, and location specified in the Advertisement for Bids.

#### **ARTICLE 22 - POST-BID INFORMATION**

- 22.1 Prior to consideration for Award of Contract, the Apparent Low Bidder shall submit for the general contractor and ALL subcontractors a completed:
- 22.1.1 Supplement J: 889 Representation Form.
- .1 Failure of the bidding entity to successfully meet the requirements of Section 889 Part B of the 2019 NDAA, either through non-use of the prohibited equipment or meeting the mitigation requirements as outlined in Supplement J, will result in the bid being rejected. Failure to meet these requirements by a proposed subcontractor will result in their rejection and trigger the actions outlined in Section 22.2.1 below.
- 22.2 The Awarded Bidder shall, within forty eight (48) hours of notification of selection for the award of a Contract for the Work, submit:

**22.2.1 Supplement G - Proposed Subcontractor Form:**

- .1 Include the following:
  - (1). A designation of the Work to be performed by the Bidder with his/her own forces.
  - (2). A list of names of the subcontractors or other persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for each principal portion of the Work including but not limited to Mechanical Work, Electrical Work, Masonry Work, and Telecommunication Work (as applicable).
  - (3). The list must include Iowa Contractor's registration numbers for all Subcontractors.
- .2 The Bidder will be required to establish to the satisfaction of the Architect and the Owner the reliability and responsibility of the proposed subcontractors or other persons or entities to furnish and perform the Work described in the Bidding Documents.
- .3 Prior to the execution of the Contract, the Architect will notify the Bidder in writing if either the Owner or the Architect, after due investigation, has reasonable objection to any subcontractor, person or entity on such list. If the Owner or Architect has a reasonable objection to any subcontractor, person or entity on such list, the Bidder may, at the Bidder's option:
  - (1). Withdraw the Bid.
  - (2). Submit an acceptable substitute subcontractor, person or entity with an adjustment in the Base Bid or Alternate Bid to cover the difference in cost occasioned by such substitution. The Owner may, accept the adjusted bid price or disqualify the Bidder. In the event of either withdrawal or disqualification under this subparagraph, bid security will not be forfeited, notwithstanding anything to the contrary in Paragraph "Bid Security" of this Section.
- .4 Subcontractors and other persons and entities proposed by the Bidder and to whom the Owner and the Architect have made no reasonable objection must be used on the Work for which they were proposed and shall not be changed except with the written consent of the Owner and the Architect.

**22.3** Prior to, or concurrent with the first Application for Payment, the Awarded Bidder shall submit a completed:

**22.3.1** Supplement B.1: Communications Schedule of Values.

**22.4** The Awarded Bidder shall, within one week following the Pre-Construction meeting and prior to purchasing any materials for the Work, submit a completed 'Sales Tax Exempt Application Form'. The Owner will email an electronic copy of the form to the General Contractor shortly after the Pre-Construction Meeting.

END OF DOCUMENT 00 21 00



GEOTECHNICAL EXPLORATION REPORT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Geotechnical Exploration Report.

1.2 RELATED SECTIONS

- A. Document 00 21 00 - Instructions to Bidders: Site Examination.

1.3 GEOTECHNICAL EXPLORATION REPORT

- A. A copy of a geotechnical exploration report, with respect to the building site, is included herein:
  - 1. Title: CAMP DODGE BATHROOM ADDITION  
Geotechnical Engineering Report
  - 2. Dated: May 2, 2023
  - 3. Prepared by: TERRACON
- B. This report identifies properties of below grade conditions at a limited number of boring locations, offers recommendations for design, and was prepared primarily for the use of the Architect/Engineer. This report is not considered part of the Drawings, Specifications, or Contract Documents.
- C. The Owner is making this report available to Bidders as information only and assumes no responsibility for its accuracy. This report, by its nature, cannot reveal all conditions existing on the site and any data indicated on the subsurface conditions are not intended as representations or warranties of the continuity of such conditions between soil borings. No claim will be considered if the Bidder relies on the information provided in this report in their bidding or their construction operations and subsequently finds that it is inaccurate.
- D. Should subsurface conditions be found to vary substantially from this report based on testing and inspection or Contractor observation, the Contractor shall promptly notify the Architect/Engineer in accordance with the General Conditions of the Contract. Should changes in design and/or construction be required, such changes will be described by the Architect/Engineer and equitable adjustment in the Contract Sum or Contract Time, or both will be made in accordance with the General Conditions of the Contract.

END OF DOCUMENT 00 31 00


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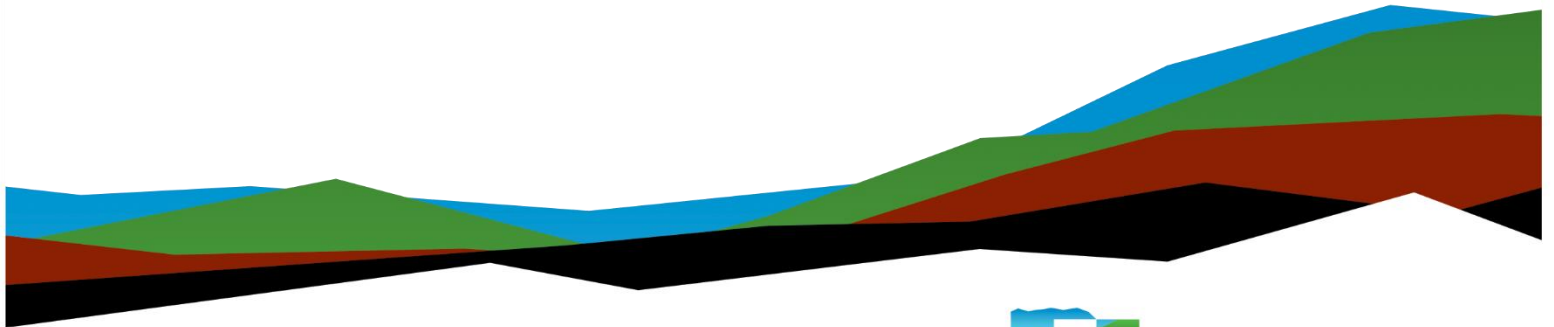
# Camp Dodge Bathroom Addition Geotechnical Engineering Report

May 2, 2023 | Terracon Project No. 08225393-01

**Prepared for:**

Shive-Hattery  
4125 Westown Pkwy Ste 100  
West Des Moines, Iowa 50266

|                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <p>I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.</p> <p style="text-align: right;"><u>May 2, 2023</u><br/>Date</p> <p>Theodore D. Bechtum, P.E.</p> <p>License Number 23812</p> <p>My license renewal date is December 31, 2024.</p> <p>Pages covered by this seal: <u>All pages</u></p> |
|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|



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May 2, 2023

Shive-Hattery  
4125 Westown Pkwy Ste 100  
West Des Moines, Iowa 50266

Attn: Brent Strauch  
P: 515-223-8104  
E: [bstrauch@shive-hattery.com](mailto:bstrauch@shive-hattery.com)

Re: Geotechnical Engineering Report  
Camp Dodge Bathroom Addition  
Camp Dodge  
Johnston, Iowa  
Terracon Project No. 08225393-01

Dear Mr. Strauch:

We have completed the scope of Geotechnical Engineering services for the above referenced project in general accordance with Terracon Proposal No. P08235393 dated March 30, 2023. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations and floor slabs for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,

**Terracon**

Andrew K. Edwards, E.I.

Staff Engineer

Theodore D. Bechtum, P.E.

Senior Engineer

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GeoModel


## Attachments

**Exploration and Testing Procedures**

**Site Location and Exploration Plans**

**Exploration and Laboratory Results**

**Supporting Information**

**Note:** This report was originally delivered in a web-based format. **Blue Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the  logo will bring you

**Geotechnical Engineering Report**

Camp Dodge Bathroom Addition | Johnston, Iowa

May 2, 2023 | Terracon Project No. 08225393-01



back to this page. For more interactive features, please view your project online at [client.terracon.com](https://client.terracon.com).

Refer to each individual Attachment for a listing of contents.

## Introduction

This report presents the results of our subsurface exploration and Geotechnical Engineering services performed for the proposed bathroom addition to be located at Camp Dodge in Johnston, Iowa. The purpose of these services was to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Subsurface water conditions
- Site preparation and earthwork
- Dewatering considerations
- Foundation design and construction
- Floor slab design and construction

The geotechnical engineering Scope of Services for this project included the advancement of test borings, laboratory testing, engineering analysis, and preparation of this report.

Drawings showing the site and boring locations are shown on the [Site Location](#) and [Exploration Plan](#), respectively. Results of the laboratory testing performed on soil samples obtained from the site during our field exploration are included on the boring logs in the [Exploration Results](#) section.

## Project Description

Our initial understanding of the project was provided in our proposal and was discussed during project planning. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

| Item                         | Description                                                                                                                                                                                            |
|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Project Description</b>   | This project includes the addition of a single story bathroom north of an existing building in Camp Dodge, Iowa.                                                                                       |
| <b>Proposed Structure</b>    | Structures associated with the project include an approximately 5,000 square foot addition to an existing training facility in Camp Dodge, Iowa. The structure will be single story and slab on grade. |
| <b>Building Construction</b> | Masonry walls supported on continuous footing foundations.                                                                                                                                             |

| Item                                 | Description                                                                                                                                                                                             |
|--------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Finished Floor Elevation</b>      | We understand the finished floor elevation will match the existing building finished floor elevation.                                                                                                   |
| <b>Maximum Loads</b>                 | The following loads were used in our analysis of settlement: <ul style="list-style-type: none"> <li>■ Walls: 3 kips per linear foot (klf)</li> <li>■ Slabs: 100 pounds per square foot (psf)</li> </ul> |
| <b>Grading/Slopes</b>                | Cuts of less than about 1 foot and fills on the order of 2 feet or less are anticipated to develop final grade.                                                                                         |
| <b>Below-Grade Structures</b>        | None.                                                                                                                                                                                                   |
| <b>Free-Standing Retaining Walls</b> | None.                                                                                                                                                                                                   |

Terracon should be notified if any of the above information is inconsistent with the planned construction, especially the grading limits, as modifications to our recommendations may be necessary.

## Site Conditions

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

| Item                         | Description                                                                                                                                                    |
|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Parcel Information</b>    | The project is located at Camp Dodge Building S-29 in Johnston, Iowa. Latitude/Longitude (approximate): 41.7010, -93.7174<br>See <a href="#">Site Location</a> |
| <b>Existing Improvements</b> | Existing building and sidewalk adjacent to the south of the planned borings. Existing parking lot to the east.                                                 |
| <b>Current Ground Cover</b>  | Light vegetative cover.                                                                                                                                        |
| <b>Existing Topography</b>   | Site is relatively flat with less than 2 feet of relief observed between borings.                                                                              |

## Geotechnical Characterization

We have developed a general characterization of the subsurface conditions based on our review of the subsurface exploration, laboratory data, geologic setting and our



understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical evaluation and recommendations of the site. Conditions observed at each exploration point are indicated on the individual logs. The individual logs can be found in the [Exploration Results](#) and the GeoModel can be found in the [Figures](#) attachment of this report.

As part of our review, we identified the following model layers within the subsurface profile. For a more detailed view of the model layer depths at each boring location, refer to the GeoModel.

| Model Layer | Layer Name   | General Description                                                                                                             |
|-------------|--------------|---------------------------------------------------------------------------------------------------------------------------------|
| 1           | Root Zone    | Root laden zone of surficial soil                                                                                               |
| 2           | Upper soils  | Sandy lean clay and clayey sand. Variable fines content.                                                                        |
| 3           | Sands        | Poorly graded sand with trace clay and gravel. Generally loose to medium dense with occasional areas of lower relative density. |
| 4           | Glacial Till | Sandy lean clay. Trace gravel. Generally stiff.                                                                                 |

Observed subsurface water levels are shown on the boring logs. Subsurface water conditions may be different at the time of construction. Mapping by the Natural Resources Conservation Service (NRCS) indicates a seasonal high groundwater level within 12 to 24 inches of ground surface. Groundwater conditions may change because of seasonal variations in rainfall, runoff, and other conditions not apparent at the time of drilling. Long-term groundwater monitoring was outside the Scope of Services for this project.

It is common for water to become perched in interlayered sand and clay soils, and the water observation in Boring 2 is anticipated to possibly correspond to perched water. Water levels at the time of construction and over the life of the structure should be anticipated to vary from the levels shown on the boring logs.

## Geotechnical Overview

The site appears suitable for the proposed construction based on geotechnical conditions observed in the soil borings, provided the recommendations provided in this report are implemented in the design and construction phases of this project.

The subsurface materials generally consisted of an upper layer with varying sand and clay content underlain by sand with varying amounts of clay and gravel extending to the maximum depth of the borings. Subsurface water was encountered at depths ranging

from 6½ feet below ground surface (bgs) to 14 feet bgs during or at the completion of drilling.

Based on the conditions encountered and estimated load-settlement relationships, it is our opinion that the proposed structures can be supported on conventional continuous footings provided consideration is given to careful bearing surface evaluation and preparation, as outlined in this report.

The recommendations contained in this report are based on the results of field and laboratory testing (presented in the **Exploration Results**), engineering analyses, and our current understanding of the proposed project. The **General Comments** section provides an understanding of the report limitations.

## Earthwork

Earthwork is anticipated to include demolition, clearing and grubbing, excavations, and structural fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria, as necessary, to render the site in the state considered in our geotechnical engineering evaluation for foundations, floor slabs, and pavements.

### Site Preparation

Site preparation within planned new construction areas should commence with:

- Removal of sidewalks and aggregate within addition footprint
- Stripping of vegetation, organic soils, root systems, and any unsuitable materials (e.g. debris, desiccated soil, frozen soil, etc.)

Although no evidence of fill or underground facilities (such as basements and utilities) was observed during the exploration and site reconnaissance, such features could be encountered during construction. If unexpected fills or underground facilities are encountered, such features should be removed, and the excavation thoroughly cleaned prior to backfill placement and/or construction.

Demolition of existing utilities and structures should be performed with close construction observation and testing. Any unsuitable fill or demolition debris should be removed. Demolition contractors should be aware of project requirements for earthwork (e.g., structural fill placement and compaction) so that reworking fill materials placed by demolition contractors is not necessary prior to construction of new structures. Demolition should be observed by Terracon and new structural fill placed in accordance with the recommendations in this report.

## Subgrade Preparation

Subsequent to stripping and removal of unsuitable soils and prior to placement of fill in areas below design grade and after completion of rough grading in cut areas of the site, the exposed clay subgrade soils should be scarified to a depth of 9 inches, moisture conditioned, and compacted to the density and water content ranges recommended in this report for structural fill. The compacted subgrade should then be proof rolled. The proof rolling, and surficial compaction will aid in providing a firm base for compaction of new fill and delineating soft or disturbed areas that may exist at or near the exposed subgrade level. Unstable areas observed at this time should be improved through use of subgrade stabilization. Subgrade stability should be observed by Terracon personnel under the direction of a geotechnical engineer during construction.

## Soil Stabilization

Methods of subgrade improvement, as described below, could include scarification, moisture conditioning and compaction or removal of unstable materials and replacement with granular fill (with or without geosynthetics). The appropriate method of improvement, if required, would be dependent on factors such as schedule, weather, the size and depth of area to be stabilized, and the nature of the instability. More detailed recommendations can be provided during construction as the need for subgrade stabilization occurs. Performing site grading operations during warm seasons and dry periods would help reduce the amount of subgrade stabilization required.

If the exposed subgrade is unstable during proofrolling operations, it could be stabilized using one of the methods outlined below.

- **Scarification and Compaction** - It may be feasible to scarify, dry, and compact the exposed soils. The success of this procedure would depend primarily on favorable weather and sufficient time to dry the soils. Stable subgrades likely would not be achievable if the thickness of the unstable soil is greater than about 1 foot, if the unstable soil is at or near groundwater levels, or if construction is performed during a period of wet or cool weather when drying is difficult.
- **Crushed Stone** - The use of crushed stone or crushed gravel is a common procedure to improve subgrade stability. The use of geotextiles (i.e., engineering fabric or geogrid) could also be considered after underground work such as utility construction is completed. Prior to placing the fabric or geogrid, we recommend that all below grade construction, such as utility line installation, be completed to avoid damaging the fabric or geogrid. Equipment should not be operated above the fabric or geogrid until one full lift of crushed stone fill is placed above it. The maximum particle size of granular material placed over geotextile fabric or geogrid should not exceed 1-1/2 inches. The specifications of the reinforcement

product manufacturer should be verified prior to material purchase/delivery and placement at the site.

Further evaluation of the need and recommendations for subgrade stabilization can be provided during construction as the geotechnical conditions are exposed.

## Fill Material Types

Fill required to achieve design grade should be classified as structural fill and general fill. Structural fill is material used below, or within 10 feet of structures. General fill is material used to achieve grade outside of these areas.

Fine grained materials (e.g., clays) can be difficult to compact in relatively small areas (e.g., excavations for foundations and utilities), and we recommend fine-grained materials are only used where placed with proper equipment during mass grading or in broad excavations.

Care should be taken to avoid interlaying clay and sand soils to help reduce the potential for developing perched water conditions.

Regardless of its source, compacted fill should consist of approved materials that are free of organic material and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade.

**Reuse of On-Site Soil:** Excavated on-site soil may be selectively reused.

Material property requirements for on-site soil for use as general fill and structural fill are noted in the table below:

| Property                                            | General Fill                 | Structural Fill                                               |
|-----------------------------------------------------|------------------------------|---------------------------------------------------------------|
| Composition                                         | Free of deleterious material | Free of deleterious material                                  |
| Maximum particle size                               | 3 inches                     | 3 inches                                                      |
| Plasticity                                          | Not limited                  | Maximum liquid limit of 45 and maximum plasticity index of 23 |
| GeoModel Layer Expected to be Suitable <sup>1</sup> | 2, 3, 4                      | 2, 3, 4                                                       |

1. Based on subsurface exploration. Actual material suitability should be determined in the field at time of construction.

**Imported Fill Materials:** Imported fill materials should meet the following material property requirements. Regardless of its source, compacted fill should consist of

approved materials that are free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade.

| Soil Type <sup>1</sup>           | USCS Classification            | Acceptable Parameters (for Structural Fill)                                                                                                                         |
|----------------------------------|--------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Imported Low Plasticity Cohesive | CL                             | Liquid Limit less than 45 and Plasticity Index less than 23 <ul style="list-style-type: none"> <li>Below aggregate base for grade-supported slabs</li> </ul>        |
| Granular                         | GW, GP, GM, GC, SW, SP, SM, SC | Specific material requirements will be to be satisfied based on the intended use <ul style="list-style-type: none"> <li>Below foundations and floor slab</li> </ul> |

1. Structural and general fill should consist of approved materials free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the Geotechnical Engineer for evaluation prior to use on this site. Additional geotechnical consultation should be provided prior to use of uniformly graded gravel on the site.

### Fill Placement and Compaction Requirements

Structural and general fill should meet the following compaction requirements. Importing moderate to high plasticity fill (i.e., Liquid Limit greater than 45 or Plasticity Index greater than 23) is not recommended.

| Item                                                    | Structural Fill                                                                                                                                                                                       | General Fill                                        |
|---------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|
| <b>Maximum Lift Thickness</b>                           | 9 inches or less in loose thickness when heavy, self-propelled compaction equipment is used<br>4 inches in loose thickness when hand-guided equipment (i.e., jumping jack or plate compactor) is used | Same as structural fill                             |
| <b>Minimum Compaction Requirements <sup>1,2,3</sup></b> | Fine grained cohesive: <ul style="list-style-type: none"> <li>95% of maximum</li> </ul> Granular: <ul style="list-style-type: none"> <li>98% of maximum</li> </ul>                                    | 95% of max.                                         |
| <b>Water Content Range <sup>1</sup></b>                 | Low plasticity cohesive: -2% to +3% of optimum<br>Granular: -3% to +3% of optimum                                                                                                                     | As required to achieve min. compaction requirements |

| Item | Structural Fill                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | General Fill |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
|      | <ol style="list-style-type: none"><li>1. Maximum density and optimum water content as determined by the standard Proctor test (ASTM D 698).</li><li>2. High plasticity cohesive fill should not be compacted to more than 100% of standard Proctor maximum dry density.</li><li>3. If the granular material is a coarse sand or gravel, or of a uniform size, or has a low fines content, compaction comparison to relative density may be more appropriate. In this case, granular materials should be compacted to at least 70% relative density (ASTM D 4253 and D 4254). Materials not amenable to density testing should be placed and compacted to a stable condition observed by the Geotechnical Engineer or representative.</li></ol> |              |

### Utility Trench Backfill

Any soft or unsuitable materials encountered at the bottom of utility trench excavations should be removed and replaced with structural fill or bedding material in accordance with public works specifications for the utility to be supported. This recommendation is particularly applicable to utility work requiring grade control and/or in areas where subsequent grade raising could cause settlement in the subgrade supporting the utility. Trench excavation should not be conducted below a downward 1:1 (horizontal to vertical) projection from existing foundations without engineering review of shoring requirements and geotechnical observation during construction.

Trench backfill should be mechanically placed and compacted as discussed earlier in this report. Compaction of initial lifts should be accomplished with hand-operated tampers or other lightweight compactors. Where trenches are placed beneath slabs or footings, the backfill should satisfy the gradation and plasticity requirements of structural fill discussed in this report. Flooding or jetting for placement and compaction of backfill is not recommended.

All trench excavations should be made with sufficient working space to permit construction, including backfill placement and compaction. If utility trenches are backfilled with relatively clean granular material, they should be capped with at least 18 inches of clay fill in non-pavement areas to reduce the infiltration and conveyance of surface water through the trench backfill.

Utility trenches are a common source of water infiltration and migration. Utility trenches constructed in clay soils that penetrate beneath the building should be effectively sealed to restrict water intrusion and flow through the trenches that could migrate below the building. We recommend constructing an effective clay "trench plug" of either low permeability clay soil or flowable fill that extends at least 5 feet out from the face of the building exteriors. If clay soils are used for the plug, the material should be compacted at or above the soil's optimum water content. The clay soil or flowable fill should be

placed to completely surround the utility line and any granular envelope, and be compacted or placed in accordance with recommendations in this report. Care should be taken as to not damage the in-place utility.

## Grading and Drainage

During earthwork, the site should be graded to prevent ponding of surface water on the prepared subgrade or in excavations. Surface water should be promptly removed. Water seepage could occur in foundation and utility excavations during construction.

Dewatering will be required where seepage is encountered and should be addressed in advance of construction. The contractor is responsible for employing appropriate dewatering methods to control seepage and the level of groundwater and facilitate construction. In our experience, dewatering of isolated excavations in clay soils can typically be accomplished using sump pits and pumps; however, more extensive dewatering systems would likely be required were excavations extend below seasonal groundwater levels or into water-bearing sand seams or layers.

All grades must provide effective drainage away from the building during and after construction and should be maintained throughout the life of the structure. Water retained next to the building can result in soil movements greater than those discussed in this report. Greater movements can result in unacceptable differential floor slab and/or foundation movements, cracked slabs and walls, and roof leaks. The roof should have gutters/drains with downspouts that discharge onto splash blocks at a distance of at least 10 feet from the building.

Exposed ground should be sloped and maintained at a minimum 5% away from the building for at least 10 feet beyond the perimeter of the building. Locally, flatter grades may be necessary to transition ADA access requirements for flatwork. After building construction and landscaping have been completed, final grades should be verified to document effective drainage has been achieved. Grades around the structure should also be periodically inspected and adjusted, as necessary, as part of the structure's maintenance program. Where paving or flatwork abuts the structure, a maintenance program should be established to effectively seal and maintain joints and prevent surface water infiltration.

## Earthwork Construction Considerations

Shallow excavations for the proposed structure are anticipated to be accomplished with conventional construction equipment. Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to construction of grade-supported improvements such as floor slabs. Construction traffic over the completed subgrades should be avoided. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Water collecting over or

adjacent to construction areas should be removed. If the subgrade freezes, desiccates, saturates, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and compacted prior to construction.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, "Excavations" and its appendices, and in accordance with any applicable local and/or state regulations.

Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean Terracon is assuming responsibility for construction site safety or the contractor's activities; such responsibility shall neither be implied nor inferred.

Excavations or other activities resulting in ground disturbance have the potential to affect adjoining properties and structures. Our Scope of Services does not include review of available final grading information or consider potential temporary grading performed by the contractor for potential effects such as ground movement beyond the project limits. A preconstruction/ precondition survey should be conducted to document nearby property/infrastructure prior to any site development activity. Excavation or ground disturbance activities adjacent or near property lines should be monitored or instrumented for potential ground movements that could negatively affect adjoining property and/or structures.

## Construction Observation and Testing

The earthwork efforts should be observed by the Geotechnical Engineer (or others under their direction). Observation should include documentation of adequate removal of surficial materials (vegetation, topsoil, and sidewalk/aggregate), as well as proofrolling and mitigation of unsuitable areas delineated by the proofroll.

Each lift of compacted fill should be tested, evaluated, and reworked, as necessary, as recommended by the Geotechnical Engineer (i.e., Terracon) prior to placement of additional lifts. Each lift of fill should be tested for density and water content at a frequency of at least one test for every 2,500 square feet of compacted fill in the building areas. Additional tests at increased frequency should be completed in relatively confined areas. Where not specified by local ordinance, one density and water content test should be performed for every 50 linear feet of compacted utility trench backfill and a minimum of one test performed for every lift.

In areas of foundation excavations, the bearing subgrade should be evaluated by the Geotechnical Engineer (i.e., Terracon). If unanticipated conditions are observed, the Geotechnical Engineer should recommend mitigation options.



In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer’s evaluation of subsurface conditions, including assessing variations and associated design changes.

## Shallow Foundations

If the site has been prepared in accordance with the requirements noted in **Earthwork**, the following design parameters are applicable for shallow foundations.

Remediation below foundations, potentially consisting of recompaction of sand soils and possible limited overexcavations, should be anticipated to develop suitable bearing conditions.

### Design Parameters – Compressive Loads

| Item                                                                                   | Description                                                           |
|----------------------------------------------------------------------------------------|-----------------------------------------------------------------------|
| <b>Maximum Net Allowable Bearing Pressure</b> <sup>1, 2</sup>                          | 1,500 psf - foundation bearing on undisturbed, native soils           |
| <b>Required Bearing Stratum</b> <sup>3</sup>                                           | Medium stiff to stiff native clay soils<br>Medium dense sand          |
| <b>Minimum Foundation Dimensions</b>                                                   | Continuous footings: 18 inches<br>Isolated column footings: 30 inches |
| <b>Ultimate Passive Resistance</b> <sup>4</sup><br><b>(equivalent fluid pressures)</b> | 285 pcf (cohesive backfill)<br>360 pcf (granular backfill)            |
| <b>Ultimate Coefficient of Sliding Friction</b> <sup>5</sup>                           | On suitable bearing material: 0.3                                     |
| <b>Minimum Embedment below Finished Grade</b> <sup>6</sup>                             | Exterior footings: 42 inches                                          |
| <b>Estimated Total Settlement from Structural Loads</b> <sup>2, 7</sup>                | Less than about 1 inch                                                |
| <b>Estimated Differential Settlement</b> <sup>2, 7, 8</sup>                            | About $\frac{3}{4}$ of total settlement                               |

| Item | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.   | The maximum net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. Values consider that exterior grades are no steeper than 20% within 10 feet of structure.                                                                                                                                                                                                                                                                                                               |
| 2.   | Values provided are for maximum loads noted in <b>Project Description</b> . Additional geotechnical consultation will be necessary if higher loads are anticipated.                                                                                                                                                                                                                                                                                                                                                                                        |
| 3.   | Unsuitable or soft soils should be overexcavated and replaced per the recommendations presented in <b>Earthwork</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 4.   | Use of passive earth pressures require the sides of the excavation for the spread footing foundation to be nearly vertical and the concrete placed neat against these vertical faces or that footing forms be removed and compacted structural fill be placed against the vertical footing face. Does not consider hydrostatic pressure. Passive resistance in the upper 3½ feet of the soil profile in exterior locations should be neglected due to frost effects. Some horizontal movement of the foundation must occur to mobilize passive resistance. |
| 5.   | Can be used to compute sliding resistance where foundations are placed on suitable soil/materials. Frictional resistance is dependent on the bearing pressure which may vary due to load combinations.                                                                                                                                                                                                                                                                                                                                                     |
| 6.   | Embedment necessary to minimize the effects of frost and/or seasonal water content variations. For sloping ground, maintain depth below the lowest adjacent exterior grade within 5 horizontal feet of the structure. Minimum embedment for exterior footings applies to perimeter footings and footings beneath unheated areas. Where interior footings will not be subject to freezing weather and large moisture fluctuations during or after construction, the minimum embedment below top of slab could be reduced to 18 inches.                      |
| 7.   | Estimated settlements were analyzed using the structural loads noted in <b>Project Description</b> . The foundation settlement will depend upon the variations within the subsurface soil profile, the structural loading conditions, the embedment depth of the footings, the thickness of structural fill, and the quality of the earthwork operations                                                                                                                                                                                                   |
| 8.   | Differential settlements are noted for equivalent-loaded foundations and bearing elevation as measured over a span of 50 feet.                                                                                                                                                                                                                                                                                                                                                                                                                             |

## Construction Adjacent to Existing Building

We understand the building addition will be located adjacent to the existing building. Care should be taken to avoid undermining adjacent structures and their existing footings, walls, grade-supported slabs, and utilities during any foundation or utility excavations, or any overexcavations necessary to remove unsuitable materials.

Excavations adjacent to existing structures should not be deeper than the bottom of the existing structural elements unless the existing elements are shored or underpinned. Care should be taken during excavations to protect the existing foundations, utilities, and bearing soils. The foundation systems and bearing elevations of existing structures should be determined prior to the start of construction.

Differential settlement between the additions and the existing building is expected to approach the magnitude of the total settlement of the addition. Expansion joints should be provided between the existing building and the proposed addition to accommodate differential movements between the two structures. Underground piping between the two structures should be designed with flexible couplings and utility knockouts in foundation walls should be oversized so minor deflections in alignment do not result in breakage or distress.

New footings should bear at or near the bearing elevation of immediately adjacent existing foundations. Depending on their locations and current loads on the existing footings, footings for the new addition could cause settlement of adjacent walls. To reduce this concern and risk, clear distances at least equal to the new footing widths should be maintained between the addition's footings and footings supporting the existing building.

If the existing foundations will support additional loads from the walls of the new addition, the additional loads on the existing foundation should be anticipated to cause building settlement to occur. The structural capacity of the existing foundations should be evaluated by a licensed structural engineer where increases in loading are planned.

## Foundation Construction Considerations

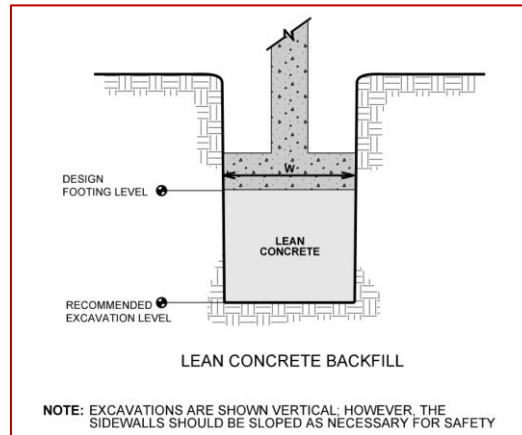
As noted in **Earthwork**, the footing excavations should be evaluated under the observation of the Geotechnical Engineer (i.e., Terracon). The base of all foundation excavations should be free of water and loose soil, prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Care should be taken to prevent wetting or drying and freezing of the bearing materials during construction. Excessively wet or dry material, frozen, or any loose/disturbed material in the bottom of the footing excavations should be removed/reconditioned before foundation concrete is placed.

Due to the sand content of the near surface soils and sand seams and layers, forming of footings might be required.

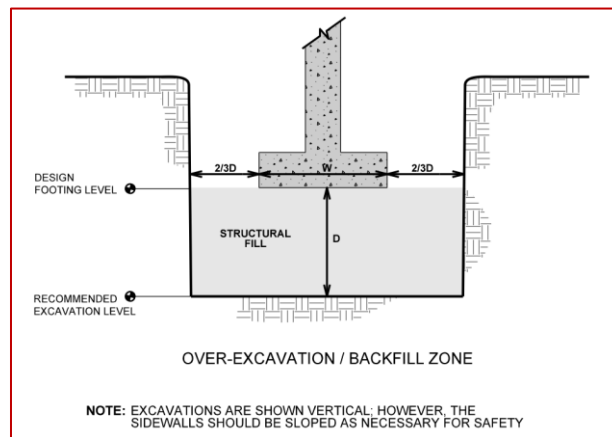
If loose native sands are exposed at foundation bearing elevation, adequate preparation could possibly be obtained by compacting loose or disturbed bearing soils, provided that groundwater is more than 2 feet below the base of the excavations. We recommend the foundation bearing surface be probed and tested at all column locations and at close intervals along strip footings before and after compaction of the bearing materials. Overexcavation of the native sand soils should be considered if very loose material is encountered or if the fines content reduces the effectiveness of compaction.

Construction of a working surface consisting of either crushed stone or a lean concrete mud mat may be required prior to the placement of reinforcing steel and construction of foundations.

If unsuitable bearing soils are observed at the base of the planned footing excavation, the excavation should be extended deeper to suitable soils, and the footings could bear directly on these soils at the lower level or on lean concrete backfill placed in the excavations. The lean concrete replacement zone is illustrated on the sketch below.



Overexcavation for structural fill placement below footings should be conducted as shown below. The overexcavation should be backfilled up to the footing base elevation with granular structural fill placed as recommended in the [Earthwork](#) section.



## Floor Slabs

Design parameters for floor slabs consider the requirements for [Earthwork](#) have been followed. Specific attention should be given to positive drainage away from the structure and positive drainage of the aggregate base beneath the floor slab.

The Geotechnical Engineer (i.e., Terracon) should evaluate the material below the floor slab prior to placement of additional fill or floor slabs. Soils below the specified water contents within this zone should be moisture conditioned or replaced with structural fill as stated in our **Earthwork** section.

### Floor Slab Design Parameters

| Item                                  | Description                                                                                  |
|---------------------------------------|----------------------------------------------------------------------------------------------|
| <b>Floor Slab Support<sup>1</sup></b> | Minimum 4 inches of free-draining granular material. <sup>2</sup>                            |
|                                       | At least 12 inches of low plasticity structural fill should be present below the floor slab. |
|                                       | Subgrade compacted to recommendations in <b>Earthwork</b>                                    |

1. Floor slabs should be structurally independent of building footings or walls to reduce the possibility of floor slab cracking caused by differential movements between the slab and foundation.
2. Clean, well-graded crushed stone containing less than 6 percent fines (material passing the #200 sieve), e.g., IaDOT granular subbase (Section 4121). Other design considerations such as cold temperatures and condensation development could warrant more extensive design provisions.

The use of a vapor retarder should be considered beneath concrete slabs on grade covered with wood, tile, carpet, or other moisture sensitive or impervious coverings, when the project includes humidity-controlled areas, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

Saw-cut contraction joints should be placed in the slab to help control the location and extent of cracking. For additional recommendations, refer to the ACI Design Manual. Joints or cracks should be sealed with a waterproof, non-extruding compressible compound specifically recommended for heavy duty concrete pavement and wet environments.

Where floor slabs are tied to perimeter walls or turn-down slabs to meet structural or other construction objectives, our experience indicates differential movement between the walls and slabs will likely be observed in adjacent slab expansion joints or floor slab cracks beyond the length of the structural dowels. The Structural Engineer should account for potential differential settlement through use of sufficient control joints, appropriate reinforcing or other means.

## Floor Slab Construction Considerations

Finished subgrade, within and for at least 10 feet beyond the floor slab, should be protected from traffic, rutting, or other disturbance and maintained in a relatively moist condition until floor slabs are constructed. If the subgrade should become damaged or desiccated prior to construction of floor slabs, the affected material should be removed, and structural fill should be added to replace the resulting excavation. Final conditioning and recompaction of the finished subgrade should be performed immediately prior to placement of the floor slab support course.

The Geotechnical Engineer (i.e., Terracon) should observe the condition of the floor slab subgrades immediately prior to placement of the floor slab support course, reinforcing steel, and concrete. Attention should be paid to high traffic areas that were rutted and disturbed earlier, and to areas where backfilled trenches are located.

Care will be necessary to avoid contaminating the aggregate base layer located directly below the floor slabs with soil prior to floor slab placement. We recommend the aggregate base layer be placed only immediately prior to slab concrete placement.

## Frost Considerations

The soils on this site are frost susceptible, and small amounts of water can affect the performance of the slabs on-grade. Exterior slabs should be anticipated to heave during winter months. If frost action needs to be reduced in critical areas, we recommend the use of low-frost susceptible (LFS) fill or structural slabs (for instance, structural stoops in front of building doors). Low-frost susceptible materials should consist of a well-graded, clean granular material with less than 6% passing the No. 200 sieve. Placement of LFS material in large areas may not be feasible; however, the following recommendations are provided to help reduce potential frost heave:

- Provide surface drainage away from the building and slabs, and toward the site drainage system.
- Install drains around the perimeter of the building, stoops, below exterior slabs, and connect them to the site drainage system.
- Grade clayey subgrades so groundwater potentially perched in overlying fill or aggregate base, slope toward a site drainage system.
- Place LFS fill as backfill beneath slabs critical to the project.
- Place a 3 horizontal to 1 vertical (3H:1V) transition zone between LFS fill and other soils.
- Place LFS materials in critical sidewalk areas.

## General Comments

Our analysis and opinions are based on our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance on the services and any work product is limited to our client and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly effect excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety and cost estimating including excavation support and dewatering requirements/design are the responsibility of others. Construction and site development have the potential to affect adjacent properties. Such impacts can include damages due to vibration, modification of groundwater/surface water flow during construction, foundation movement due to undermining or subsidence from excavation, as well as noise or air quality concerns. Evaluation of these items on nearby properties are commonly associated with contractor means and methods and are not addressed in this report. The owner and contractor should consider a preconstruction/precondition survey of surrounding development. If changes in the nature, design, or location of the project are planned, our conclusions and

**Geotechnical Engineering Report**

Camp Dodge Bathroom Addition | Johnston, Iowa

May 2, 2023 | Terracon Project No. 08225393-01



recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.



## Geotechnical Engineering Report

Camp Dodge Bathroom Addition | Johnston, Iowa

May 2, 2023 | Terracon Project No. 08225393-01

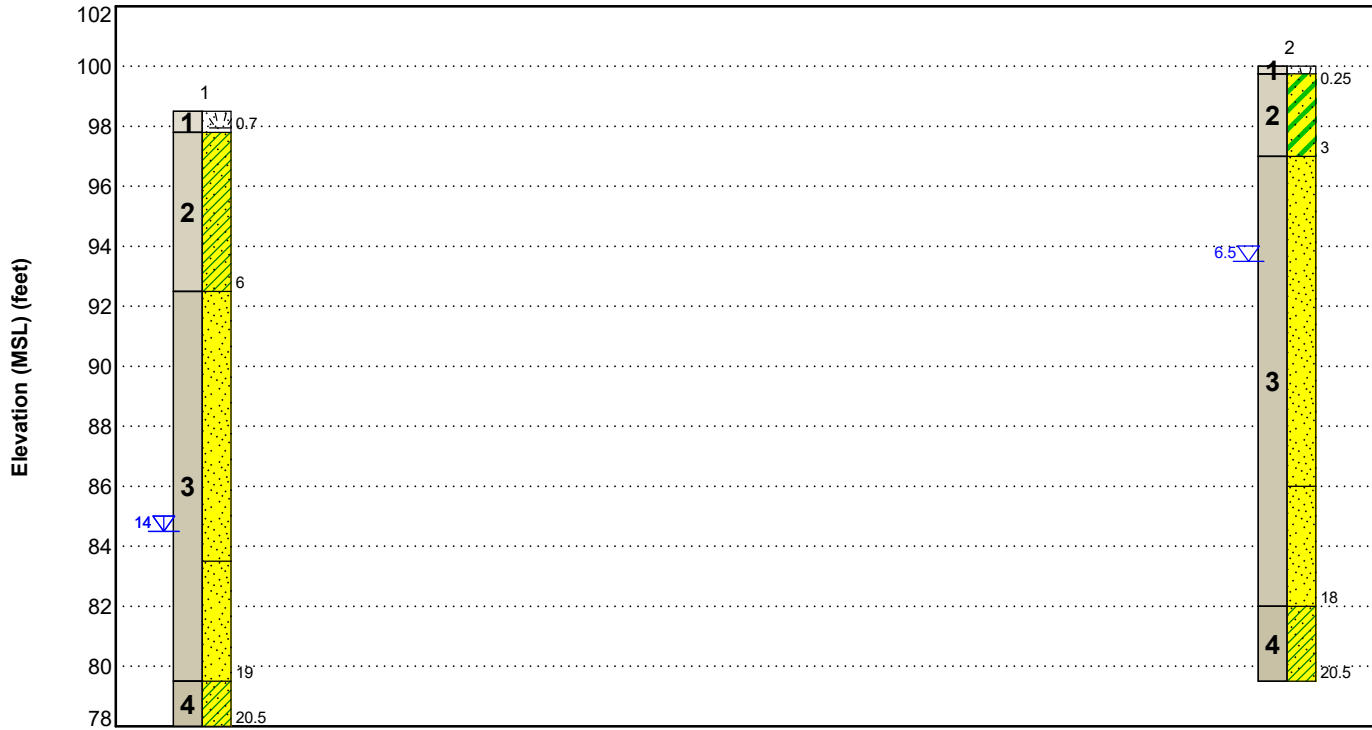


# Figures

## Contents:

GeoModel

## GeoModel



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

| Model Layer | Layer Name   | General Description                                                                                                             |
|-------------|--------------|---------------------------------------------------------------------------------------------------------------------------------|
| 1           | Root Zone    | Root laden zone of surficial soil                                                                                               |
| 2           | Upper Soils  | Sandy lean clay and clayey sand. Variable fines content.                                                                        |
| 3           | Sands        | Poorly graded sand with trace clay and gravel. Generally loose to medium dense with occasional areas of lower relative density. |
| 4           | Glacial Till | Sandy lean clay. Trace gravel. Generally stiff.                                                                                 |

### LEGEND

- Topsoil
- Clayey Sand
- Sandy Lean Clay
- Poorly-graded Sand

- First Water Observation
- Second Water Observation

The groundwater levels shown are representative of the date and time of our exploration. Significant changes are possible over time. Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

**NOTES:**

Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project. Numbers adjacent to soil column indicate depth below ground surface.

**Geotechnical Engineering Report**

Camp Dodge Bathroom Addition | Johnston, Iowa

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## Attachments

# Exploration and Testing Procedures

## Field Exploration

| Number of Borings | Approximate Boring Depth (feet) | Location          |
|-------------------|---------------------------------|-------------------|
| 2                 | 20.5                            | Addition vicinity |

**Boring Layout and Elevations:** Terracon personnel provided the boring layout using handheld GPS equipment (estimated horizontal accuracy of about  $\pm 20$  feet) and referencing measurements from existing site features. Approximate ground surface elevations were obtained by the drill crew using a level and grade rod referenced to the existing building finished floor elevation. If elevations and a more precise boring layout are desired, we recommend borings be surveyed.

**Subsurface Exploration Procedures:** We advanced the borings with a truck-mounted rotary drill rig using continuous flight augers (solid stem and/or hollow stem, as necessary, depending on soil conditions). Four samples were obtained in the upper 10 feet of each boring and at intervals of 5 feet thereafter. In the thin-walled tube sampling procedure, a thin-walled, seamless steel tube with a sharp cutting edge was pushed hydraulically into the soil to obtain a relatively undisturbed sample. In the split-barrel sampling procedure, a standard 2-inch outer diameter split-barrel sampling spoon was driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths.

We also observed the boreholes while drilling and at the completion of drilling for the presence of subsurface water. The subsurface water levels are shown on the attached boring logs.

The sampling depths, penetration distances, and other sampling information was recorded on the field boring logs. The samples were placed in appropriate containers and transported to our soil laboratory for testing and classification. Our exploration team prepared field boring logs as part of the drilling operations. These field logs included visual classifications of the materials observed during drilling and our interpretation of the subsurface conditions between samples. Final boring logs were prepared from the field logs. The final boring logs represent the Geotechnical Engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

## Laboratory Testing

The project engineer reviewed the field data and assigned laboratory tests. The laboratory testing program included the following types of tests:

- Water Content
- Dry Unit Weight
- Unconfined Compression

The laboratory testing program often included examination of soil samples by an engineer. Based on the results of our field and laboratory programs, we described and classified the soil samples in general accordance with the Unified Soil Classification System.

**Geotechnical Engineering Report**

Camp Dodge Bathroom Addition | Johnston, Iowa  
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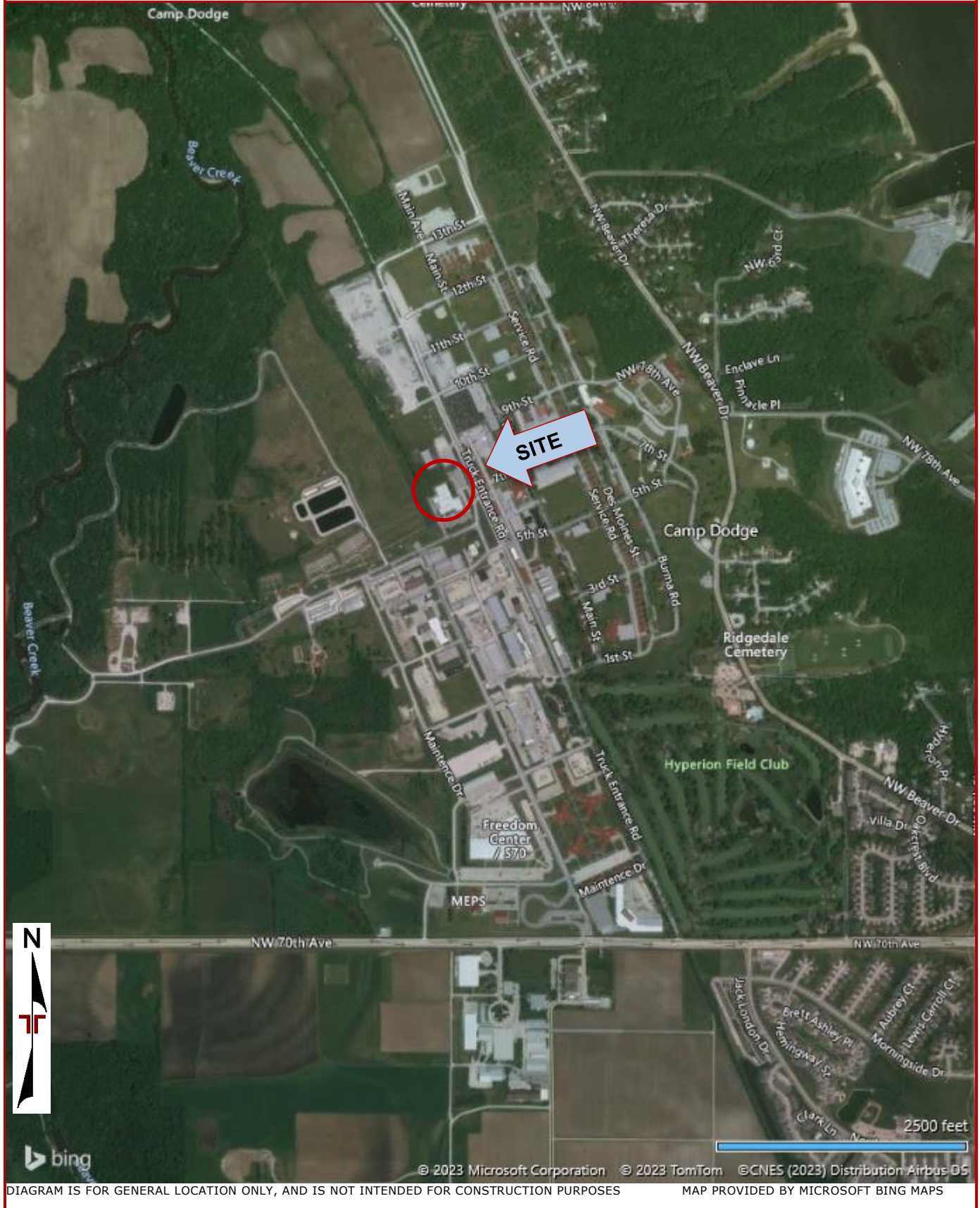
## Site Location and Exploration Plans

**Contents:**

Site Location Plan  
Exploration Plan

Note: All attachments are one page unless noted above.

## Site Location



## Exploration Plan



DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS



## **Exploration and Laboratory Results**

### **Contents:**

Boring Logs (B-1 through B-2)

Note: All attachments are one page unless noted above.

# Boring Log No. 1

| Model Layer | Graphic Log | Location: See Exploration Plan<br>Latitude: 41.7010° Longitude: -93.7176°<br>Depth (Ft.) Elevation: 98.5 (Ft.) +/- | Depth (Ft.) | Water Level Observations | Sample Type | Recovery (In.) | Field Test Results        | SAMPLE ID | HP (psf) | Unconfined Compressive Strength (psf) | Water Content (%) | Dry Unit Weight (pcf) |
|-------------|-------------|--------------------------------------------------------------------------------------------------------------------|-------------|--------------------------|-------------|----------------|---------------------------|-----------|----------|---------------------------------------|-------------------|-----------------------|
| 1           |             | <b>Approx. 7" Root Zone</b>                                                                                        | 0.7 97.8    |                          |             |                |                           |           |          |                                       |                   |                       |
| 2           |             | <b>SANDY LEAN CLAY (CL)</b> , dark brown to brown, medium stiff                                                    |             |                          |             |                |                           |           |          |                                       |                   |                       |
|             |             |                                                                                                                    |             |                          | X           | 6              | 2-2-2<br>N=4<br>2000 (HP) | 1         |          |                                       | 16.5              |                       |
|             |             |                                                                                                                    |             |                          | █           | 12             |                           | 2         |          | 1330                                  | 15.3              | 104                   |
|             |             |                                                                                                                    | 6.0 92.5    |                          |             |                |                           |           |          |                                       |                   |                       |
|             |             | <b>SAND (SP)</b> , trace clay, fine to medium grained, brown, medium dense to loose                                |             |                          | X           | 15             | 7-9-11<br>N=20            | 3         |          |                                       | 11.9              |                       |
|             |             |                                                                                                                    |             |                          | X           | 12             | 2-3-3<br>N=6              | 4         |          |                                       | 7.2               |                       |
|             |             |                                                                                                                    |             |                          |             |                |                           |           |          |                                       |                   |                       |
|             |             |                                                                                                                    |             | ▽                        | X           | 11             | 1-3-5<br>N=8              | 5         |          |                                       | 21.1              |                       |
|             |             | <b>SANDY LEAN CLAY (CL)</b> , trace gravel, gray, stiff                                                            | 19.0 79.5   |                          | X           | 7              | 4-5-3<br>N=8<br>2000 (HP) | 6         |          |                                       | 16.7              |                       |
|             |             | <b>Boring Terminated at 20.5 Feet</b>                                                                              | 20.5 78     |                          |             |                |                           |           |          |                                       |                   |                       |

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).  
 See [Supporting Information](#) for explanation of symbols and abbreviations.

**Notes**

**Water Level Observations**

- ▽ 14' While Drilling
- ▽ 14' After completion

**Drill Rig**  
837

**Hammer Type**  
Automatic

**Driller**  
ZT

**Logged by**  
AE

**Boring Started**  
04-10-2023

**Boring Completed**  
04-10-2023

**Advancement Method**  
Power Auger

**Abandonment Method**  
Boring backfilled with auger cuttings upon completion.

## Boring Log No. 2

| Model Layer | Graphic Log | Location: See <a href="#">Exploration Plan</a><br>Latitude: 41.7010° Longitude: -93.7172°<br>Depth (Ft.) _____ Elevation: 100 (Ft.) +/- _____ | Depth (Ft.) | Water Level Observations | Sample Type | Recovery (In.) | Field Test Results | SAMPLE ID | HP (psf) | Unconfined Compressive Strength (psf) | Water Content (%) | Dry Unit Weight (pcf) |
|-------------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------------------|-------------|----------------|--------------------|-----------|----------|---------------------------------------|-------------------|-----------------------|
| 1           |             | <b>Approx. 3" Root Zone</b>                                                                                                                   | 0.3         |                          |             |                |                    |           |          |                                       |                   |                       |
| 2           |             | <b>CLAYEY SAND (SC)</b> , trace clay, fine to medium grained, dark brown to brown, very loose                                                 | 3.0         |                          |             | 8              | 2-2-1<br>N=3       | 1         |          |                                       | 12.0              |                       |
| 3           |             | <b>SAND (SP)</b> , trace clay, fine to medium grained, brown, very loose to loose, occasional clay seams                                      | 5           |                          |             | 11             | 2-1-2<br>N=3       | 2         |          |                                       | 11.6              |                       |
|             |             |                                                                                                                                               | 5           | ▽                        |             | 18             | 2-1-2<br>N=3       | 3         |          |                                       | 17.2              |                       |
|             |             |                                                                                                                                               | 10          |                          |             | 17             | 2-1-0<br>N=1       | 4         |          |                                       | 9.1               |                       |
|             |             |                                                                                                                                               | 15          |                          |             | 18             | 3-5-5<br>N=10      | 5         |          |                                       | 19.6              |                       |
| 4           |             | <b>SANDY LEAN CLAY (CL)</b> , trace gravel, gray, stiff                                                                                       | 18.0        |                          | ✎           |                |                    | 7         |          |                                       |                   |                       |
|             |             |                                                                                                                                               | 20.5        |                          |             | 0              | 3-5-6<br>N=11      | 6         |          |                                       |                   |                       |
|             |             | <b>Boring Terminated at 20.5 Feet</b>                                                                                                         | 79.5        |                          |             |                |                    |           |          |                                       |                   |                       |

|                                                                                                                                                                                                                                                                     |                                                                                                                                              |                                                                                                                                     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| <p>See <a href="#">Exploration and Testing Procedures</a> for a description of field and laboratory procedures used and additional data (If any).<br/>                 See <a href="#">Supporting Information</a> for explanation of symbols and abbreviations.</p> | <p><b>Water Level Observations</b><br/>                 ▽ 6.5' While Drilling</p>                                                            | <p><b>Drill Rig</b><br/>837</p> <p><b>Hammer Type</b><br/>Automatic</p> <p><b>Driller</b><br/>ZT</p> <p><b>Logged by</b><br/>AE</p> |
| <p><b>Notes</b></p>                                                                                                                                                                                                                                                 | <p><b>Advancement Method</b><br/>Power Auger</p> <p><b>Abandonment Method</b><br/>Boring backfilled with auger cuttings upon completion.</p> | <p><b>Boring Started</b><br/>04-10-2023</p> <p><b>Boring Completed</b><br/>04-10-2023</p>                                           |

## **Supporting Information**








### **Contents:**

General Notes

Unified Soil Classification System

Note: All attachments are one page unless noted above.

## General Notes

| Sampling                                                                                                                                                                                                                                                                                                          | Water Level                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Field Tests                                                                                                                                                                                                                             |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  Grab Sample<br> Shelby Tube<br><br> Standard Penetration Test |  Water Initially Encountered<br> Water Level After a Specified Period of Time<br> Water Level After a Specified Period of Time<br> Cave In Encountered<br><br>Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations. | N Standard Penetration Test Resistance (Blows/Ft.)<br>(HP) Hand Penetrometer<br>(T) Torvane<br>(DCP) Dynamic Cone Penetrometer<br>UC Unconfined Compressive Strength<br>(PID) Photo-Ionization Detector<br>(OVA) Organic Vapor Analyzer |

### Descriptive Soil Classification

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

### Location And Elevation Notes

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

### Strength Terms

| Relative Density of Coarse-Grained Soils<br>(More than 50% retained on No. 200 sieve.)<br>Density determined by Standard Penetration Resistance |                                             | Consistency of Fine-Grained Soils<br>(50% or more passing the No. 200 sieve.)<br>Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance |                                          |                                             |
|-------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|---------------------------------------------|
| Relative Density                                                                                                                                | Standard Penetration or N-Value (Blows/Ft.) | Consistency                                                                                                                                                                                                     | Unconfined Compressive Strength Qu (tsf) | Standard Penetration or N-Value (Blows/Ft.) |
| Very Loose                                                                                                                                      | 0 - 3                                       | Very Soft                                                                                                                                                                                                       | less than 0.25                           | 0 - 1                                       |
| Loose                                                                                                                                           | 4 - 9                                       | Soft                                                                                                                                                                                                            | 0.25 to 0.50                             | 2 - 4                                       |
| Medium Dense                                                                                                                                    | 10 - 29                                     | Medium Stiff                                                                                                                                                                                                    | 0.50 to 1.00                             | 4 - 8                                       |
| Dense                                                                                                                                           | 30 - 50                                     | Stiff                                                                                                                                                                                                           | 1.00 to 2.00                             | 8 - 15                                      |
| Very Dense                                                                                                                                      | > 50                                        | Very Stiff                                                                                                                                                                                                      | 2.00 to 4.00                             | 15 - 30                                     |
|                                                                                                                                                 |                                             | Hard                                                                                                                                                                                                            | > 4.00                                   | > 30                                        |

### Relevance of Exploration and Laboratory Test Results

Exploration/field results and/or laboratory test data contained within this document are intended for application to the project as described in this document. Use of such exploration/field results and/or laboratory test data should not be used independently of this document.

## Unified Soil Classification System

| Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests <sup>A</sup> |                                                                             |                                                                    |                                                             | Soil Classification                                       |                                                                          |
|------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|--------------------------------------------------------------------|-------------------------------------------------------------|-----------------------------------------------------------|--------------------------------------------------------------------------|
|                                                                                          |                                                                             |                                                                    |                                                             | Group Symbol                                              | Group Name <sup>B</sup>                                                  |
| <b>Coarse-Grained Soils:</b><br>More than 50% retained on No. 200 sieve                  | <b>Gravels:</b><br>More than 50% of coarse fraction retained on No. 4 sieve | <b>Clean Gravels:</b><br>Less than 5% fines <sup>C</sup>           | $Cu \geq 4$ and $1 \leq Cc \leq 3$ <sup>E</sup>             | GW                                                        | Well-graded gravel <sup>F</sup>                                          |
|                                                                                          |                                                                             | <b>Gravels with Fines:</b><br>More than 12% fines <sup>C</sup>     | $Cu < 4$ and/or $[Cc < 1$ or $Cc > 3.0]$ <sup>E</sup>       | GP                                                        | Poorly graded gravel <sup>F</sup>                                        |
|                                                                                          |                                                                             |                                                                    | Fines classify as ML or MH                                  | GM                                                        | Silty gravel <sup>F, G, H</sup>                                          |
|                                                                                          |                                                                             | <b>Sands:</b><br>50% or more of coarse fraction passes No. 4 sieve | <b>Clean Sands:</b><br>Less than 5% fines <sup>D</sup>      | Fines classify as CL or CH                                | GC                                                                       |
|                                                                                          | $Cu \geq 6$ and $1 \leq Cc \leq 3$ <sup>E</sup>                             |                                                                    |                                                             | SW                                                        | Well-graded sand <sup>I</sup>                                            |
|                                                                                          | <b>Sands with Fines:</b><br>More than 12% fines <sup>D</sup>                |                                                                    | $Cu < 6$ and/or $[Cc < 1$ or $Cc > 3.0]$ <sup>E</sup>       | SP                                                        | Poorly graded sand <sup>I</sup>                                          |
|                                                                                          |                                                                             |                                                                    | Fines classify as ML or MH                                  | SM                                                        | Silty sand <sup>G, H, I</sup>                                            |
|                                                                                          | <b>Fine-Grained Soils:</b><br>50% or more passes the No. 200 sieve          | <b>Silts and Clays:</b><br>Liquid limit less than 50               | <b>Inorganic:</b>                                           | PI > 7 and plots above "A" line <sup>J</sup>              | CL                                                                       |
| PI < 4 or plots below "A" line <sup>J</sup>                                              |                                                                             |                                                                    |                                                             | ML                                                        | Silt <sup>K, L, M</sup>                                                  |
| <b>Organic:</b>                                                                          |                                                                             |                                                                    | $\frac{LL \text{ oven dried}}{LL \text{ not dried}} < 0.75$ | OL                                                        | Organic clay <sup>K, L, M, N</sup><br>Organic silt <sup>K, L, M, O</sup> |
|                                                                                          |                                                                             |                                                                    | <b>Silts and Clays:</b><br>Liquid limit 50 or more          | <b>Inorganic:</b>                                         | PI plots on or above "A" line                                            |
| PI plots below "A" line                                                                  |                                                                             | MH                                                                 |                                                             |                                                           | Elastic silt <sup>K, L, M</sup>                                          |
| <b>Organic:</b>                                                                          |                                                                             | $\frac{LL \text{ oven dried}}{LL \text{ not dried}} < 0.75$        |                                                             | OH                                                        | Organic clay <sup>K, L, M, P</sup><br>Organic silt <sup>K, L, M, Q</sup> |
|                                                                                          |                                                                             | <b>Highly organic soils:</b>                                       |                                                             | Primarily organic matter, dark in color, and organic odor |                                                                          |

<sup>A</sup> Based on the material passing the 3-inch (75-mm) sieve.

<sup>B</sup> If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

<sup>C</sup> Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

<sup>D</sup> Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

<sup>E</sup>  $Cu = D_{60}/D_{10}$      $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$

<sup>F</sup> If soil contains  $\geq 15\%$  sand, add "with sand" to group name.

<sup>G</sup> If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

<sup>H</sup> If fines are organic, add "with organic fines" to group name.

<sup>I</sup> If soil contains  $\geq 15\%$  gravel, add "with gravel" to group name.

<sup>J</sup> If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

<sup>K</sup> If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

<sup>L</sup> If soil contains  $\geq 30\%$  plus No. 200 predominantly sand, add "sandy" to group name.

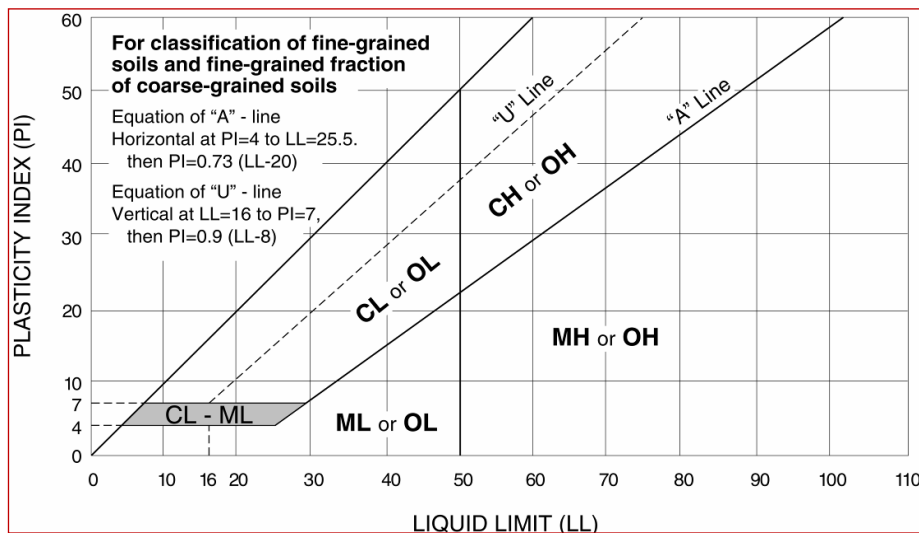
<sup>M</sup> If soil contains  $\geq 30\%$  plus No. 200, predominantly gravel, add "gravelly" to group name.

<sup>N</sup> PI  $\geq 4$  and plots on or above "A" line.

<sup>O</sup> PI < 4 or plots below "A" line.

<sup>P</sup> PI plots on or above "A" line.

<sup>Q</sup> PI plots below "A" line.



**FORM OF BID**  
for  
**CONSTRUCTION CONTRACT**

|                                                                 |                                                                 |
|-----------------------------------------------------------------|-----------------------------------------------------------------|
| <b>I. PROJECT TITLE:</b><br>S-29 MILLER ARMORY LATRINE ADDITION | <b>BID DATE:</b><br>AUGUST 22, 2024<br>AT: 1:00 p.m. Local time |
| <b>PROJECT LOCATION:</b><br>CAMP DODGE, JOHNSTON, IOWA          | <b>PROJECT NO.:</b> 19083730<br><b>CONTRACT NO.:</b> C32998060  |

TO: Iowa Army National Guard  
State Comptroller Office  
Attn: Contracting Officer  
(Reference Section 00 21 00 for Submittal of Bids)

**II. ACKNOWLEDGEMENT**

A. The undersigned Bidder, in response to your Advertisement for Bids for construction of the above project, having examined the Drawings, Specifications, and other Bidding Documents and the site of the proposed work, and being familiar with all of the conditions surrounding the construction of the proposed project including the availability of materials and labor, hereby proposes to furnish all labor, materials, and supplies, and to construct the project in accordance with the proposed Contract Documents within the time set forth therein and at the prices stated below. These prices are to cover all expenses incurred in performing the work required under the proposed Contract Documents of which this bid is a part.

B. Accompanying this proposal are the following required documents:

- 1) Supplement A: The Bid Security .....(Contractor provided document).
- 2) Supplement D: Targeted Small Business Form .....(use provided form).

C. Bidder acknowledges receipt of the following Addenda which are a part of the Bidding Documents:  
Numbers \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_.

**III. LUMP SUM PROPOSAL**

A. **BASE BID:** Bidder agrees to perform all of the work described in the proposed Contract Documents and shown on the Drawings for the Sum of:

\_\_\_\_\_  
\_\_\_\_\_ Dollars (\$ \_\_\_\_\_)

B. **ALTERNATE No. 1:** Bidder agrees to perform all of the work described in the proposed Contract Documents and shown on the Drawings. ADD / DEDUCT the Sum of:

\_\_\_\_\_  
\_\_\_\_\_ Dollars (\$ \_\_\_\_\_)

C. **Amounts will be shown in both words and figures. In case of discrepancy, the amount in words will govern.**

**IV. SCHEDULE**

- A. It is estimated that work can commence by..... \_\_\_\_\_ (mm/dd/yyyy).  
and be completed by..... \_\_\_\_\_ (mm/dd/yyyy).  
  
(Note: Not a bid award determining factor.)

**V. SUBMISSION CONDITIONS**

- A. In submitting this bid, it is understood that the Owner reserves the right to accept Alternates in any order or combination and to determine the low Bidder on the basis of the sum of the Base Bid and Alternate(s) accepted.
- B. Bidder hereby certifies: (a) that his bid is genuine and is not made in the interest of or on behalf of any undisclosed person, firm, or corporation; (b) that Bidder has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid; (c) that Bidder has not solicited or induced any person, firm, or corporation to refrain from bidding; (d) that Bidder has not sought by collusion to obtain any advantage over any other bidder or over Owner.

**VI. CONTRACTOR SIGNATURE**

- A. Respectfully Submitted:

Firm Name: \_\_\_\_\_ Telephone No.: \_\_\_\_\_

Official Address: \_\_\_\_\_ FAX No.: \_\_\_\_\_

\_\_\_\_\_ EMAIL: \_\_\_\_\_

Mailing Address: \_\_\_\_\_  
(if different from above)

\_\_\_\_\_

Signed By: \_\_\_\_\_

Printed Name: \_\_\_\_\_

\_\_\_\_\_  
(Title)

Date: \_\_\_\_\_

Federal ID No.: \_\_\_\_\_

Iowa Contractor Registration No.: \_\_\_\_\_

END OF DOCUMENT 00 41 00



DOCUMENT 00 43 13

SUPPLEMENT A:  
BID BOND

**(To be submitted with the Form of Bid if securing Bid with a Bid Bond)**

AIA Document A310 - Bid Bond, 2010 Edition, is hereby a part of the Specifications as if it were bound herein.

Copies and samples for preview of the document can be obtained online from:  
<https://www.aiacontracts.org/purchase>.

END OF DOCUMENT 00 43 13

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SUPPLEMENT B.1:  
COMMUNICATIONS SCHEDULE OF VALUES

**I. PROJECT TITLE:** S-29 MILLER ARMORY LATRINE ADDITION  
**PROJECT NO.:** 19083730  
**CONTRACT NO.:** C32998060  
**PROJECT LOCATION:**  
CAMP DODGE, JOHNSTON, IOWA

This Communications Schedule of Values shall be completed and submitted by the selected Contractor prior to, or concurrent with the first Application for Payment as per the conditions of the Instructions to Bidders. Failure to submit in a timely manner may result in delay of payment.

Instructions:

1. The Owner's contracting rules require the costs for all communications materials and equipment (including installation labor costs) be divided into two classifications. These classifications are "Real Property" and "Non-Real Property".
2. The Schedule below divides communications equipment and material into 2 (two) categories:
  - a. "**REAL PROPERTY**" – Outside Cable Plant (OSCP) *and* Inside Cable Plant (ISCP)
  - b. "**NON-REAL PROPERTY**" - Outside Cable Plant (OSCP) *and* Inside Cable Plant (ISCP)
3. The Contractor shall input the lump sum cost for "Materials and Equipment", "Installation Labor Cost", and "Total" for each category. Scan the completed document and upload to the project website.

For any communications material, equipment, or labor item provided on the project that is not included in the descriptions below, add to the lists as appropriate. Any questions regarding which category an added item (and associated cost) should be placed in shall be directed to the Owner's Telecommunication Manager: LTC Kevin Kruse @ 515-252-4357, kevin.j.kruse.mil@mail.mil.

4. All of the costs listed shall add up to the Contractor's total communications bid cost for the project.

**CATEGORY 1: "REAL PROPERTY"**

ALL Outside Cable Plant (OSCP) pathway and DMARC materials and equipment to include:

- Innerduct (PVC or Metallic)
- Conduit (PVC or Metallic)
- Hand Holes
- Hand Hole Lids
- Vaults
- Vault Lids
- Ground Rods
- Grounding Hardware
- Grounding Kits
- Grounding Wire
- Locate (Tracer) Wire
- Pull Boxes (Hoffman type enclosures) used as part of the OSCP pathway
- Pull Boxes Hardware
- Copper Cable Lightning Protector Blocks

ALL Inside Cable Plant (ISCP) pathway and DMARC materials and equipment to include:

- Innerduct (PVC or Metallic)
- Conduit (PVC or Metallic)

- Conduit Mounting Hardware
- Gang Boxes
- Gang Boxes Mounting Hardware
- Mud Rings
- Cable Basket Tray
- Cable Basket Tray Mounting Hardware
- Cable J-Hooks
- Cable J-Hooks Mounting Hardware
- Ground Rods
- Grounding Hardware
- Grounding Kits
- Grounding Wire
- Pull Boxes (Hoffman type enclosures) used as part of the ISCP pathway
- Pull Boxes Hardware
- Copper Cable Lightning Protector Blocks
- Wall Mounted Fiber Optic WIC Boxes
- Rack Mounted Fiber Optic WIC Trays
- Rack Mounted Fiber Optic CCH Type Housings

**“REAL PROPERTY”** Pathway Materials and Equipment.....\$ \_\_\_\_\_

**“REAL PROPERTY”** Installation Labor Costs.....\$ \_\_\_\_\_

Note: Labor Costs to include:

- Excavation, backfill and surface finish (i.e. seed, sod, gravel...)

**CATEGORY 1: (REAL PROPERTY) TOTAL:** ..... \$ \_\_\_\_\_

**CATEGORY 2: “NON-REAL PROPERTY”**

ALL Outside Cable Plant (OSCP) Fiber Optic cable and Copper cable to include:

- MAXCELL Fabric Socks
- Copper Cabling
- Copper Splice Cases
- Copper Splice Case Kits
- Copper Splice Case Hardware
- Copper Splice Case Mounting Kits
- Single-Mode Fiber Cabling
- Multi-Mode Fiber Cabling
- Fiber Optic Cabling Splice Cases
- Fiber Optic Cabling Splice Case Kits
- Fiber Optic Cabling Splice Case Hardware
- Fiber Optic Cabling Splice Case Mounting Kits

ALL Inside Cable Plant (ISCP) Fiber Optic cable and Copper cable to include:

- MAXCELL Fabric Sock
- Copper Cabling (Horizontal\Vertical\BackBone\DMARC\Home Run\Station)
- Copper Patch Panels
- Copper (I.T.) Station Jacks
- Wall Plates
- 110 Blocks \ 66 Blocks
- Copper Splice Cases
- Copper Splice Case Kits
- Copper Splice Case Hardware
- Copper Splice Case Mounting Kits
- Single-Mode Fiber Cabling
- Multi-Mode Fiber Cabling
- Fiber Optic Cabling Splice Cases
- Fiber Optic Cabling Splice Case Kits
- Fiber Optic Cabling Splice Case Hardware

- o Fiber Optic Cabling Splice Case Mounting Kits
- o Fiber Optic Connectors / Terminations
- o Relay Racks
- o Ladder Racking
- o Vertical and Horizontal Cable Management
- o Swing Gate (Wall Mounted) Racks
- o Hoffman type Wall Mounted Racks

**“NON-REAL PROPERTY”** Materials and Equipment .....\$ \_\_\_\_\_

**“NON-REAL PROPERTY”** Installation Labor Costs .....\$ \_\_\_\_\_

Note: Installation Labor Costs to include:

- Cable Punch-Down costs (including at the DMARC Lightning Protectors)
- Fiber Optic Terminations Installation costs

**CATEGORY 2: (NON-REAL PROPERTY) TOTAL:** ..... \$ \_\_\_\_\_

**TOTAL COMMUNICATIONS BID COST:** ..... \$ \_\_\_\_\_

END OF DOCUMENT 00 43 14.13

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SUPPLEMENT D: TARGETED SMALL BUSINESS FORM

(To be submitted with Form of Bid)

**I. PROJECT TITLE:**  
S-29 MILLER ARMORY LATRINE ADDITION

**PROJECT NO.:** 19083730  
**CONTRACT NO.:** C32998060

**PROJECT LOCATION:**  
CAMP DODGE, JOHNSTON, IOWA

\_\_\_\_\_  
Bidder's Company Name

\_\_\_\_\_  
Area Code/Telephone

\_\_\_\_\_  
Address

\_\_\_\_\_  
City

\_\_\_\_\_  
State

\_\_\_\_\_  
Zip Code

Bidder is \_\_\_\_\_ is not \_\_\_\_\_ a certified Iowa Targeted Small Business.

**INSTRUCTIONS:** Bidder shall provide the information requested below showing any Targeted Small Business Enterprise contacts made prior to bid submission for the project listed. Bidder shall use the construction-related Iowa Targeted Small Business Directory as certified by the Department of Economic Development, State of Iowa. Bidders shall comply with all affirmative action/equal opportunity provisions of State and Federal laws. The Owner seeks to provide opportunities for Targeted Small Businesses in accordance with the provisions of Chapter 73 of the Code of Iowa. Information is subject to verification and confirmation.

| TSB Company Name<br>and Phone # | Date<br>Contacted | Quote<br>Rec'd<br>(Y/N) | \$ Amount Proposed<br>(if quote used in bid) |
|---------------------------------|-------------------|-------------------------|----------------------------------------------|
|                                 |                   |                         |                                              |
|                                 |                   |                         |                                              |
|                                 |                   |                         |                                              |
|                                 |                   |                         |                                              |
|                                 |                   |                         |                                              |

(Use second sheet if needed)

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature of Bidder (same person signing the Form of Bid)

END OF DOCUMENT 00 43 16

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SUPPLEMENT F:  
SUBSTITUTION REQUEST FORM (BIDDING PHASE)

TO: **FORWARD ALL SUBSTITUTION REQUESTS TO:**  
Carly Welch, Shive-Hattery  
4125 Westown Parkway, Suite 100, West Des Moines, Iowa 50266  
515-223-8104 (phone) cwelch@shive-hattery.com (email)

PROJECT: S-29 MILLER ARMORY LATRINE ADDITION, CAMP DODGE, JOHNSTON, IOWA  
Specification: Title, Section, Page, Paragraph / Article

Proposed Substitution: Description, Manufacturer, Model, Phone No., Trade Name

Product Data: Drawings, Specifications, Performance Data, Test Data – Attached

The Undersigned Certifies: (Check each)

- Substitution is equal or superior in all respects to specified item.
- Will provide same warranty as specified item.
- Same maintenance service and source of replacement parts, as applicable, are available.
- Substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Substitution does not affect dimensions or functional clearances.
- Will coordinate installation and adjust other work which may be required, at no additional cost to the Owner.
- Waives claims for additional costs or time extensions which may subsequently become apparent.
- Will reimburse Owner for review or design services for re-approval by authorities, for changes in building design, detailing, and construction costs caused by the substitutions.

Requested By: \_\_\_\_\_

Signature: \_\_\_\_\_

Company: \_\_\_\_\_

Telephone: \_\_\_\_\_

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

Fax: \_\_\_\_\_

END OF DOCUMENT 00 43 25

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SUPPLEMENT G:  
PROPOSED SUBCONTRACTOR FORM

**(To be submitted within 48 hours of notification of selection for the award of a contract)**

**A. Work proposed to be performed by the Bidder with his/her own forces:**

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_

(attach additional pages as required)

**B. A list of names of the subcontractors or other persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for the principal portions of the Work including but not limited to the following (as applicable):**

1. Mechanical: \_\_\_\_\_
2. Electrical: \_\_\_\_\_
3. Masonry: \_\_\_\_\_
4. Geothermal: \_\_\_\_\_
5. Telecommunication: \_\_\_\_\_
6. \_\_\_\_\_
7. \_\_\_\_\_
8. \_\_\_\_\_
9. \_\_\_\_\_
10. \_\_\_\_\_
11. \_\_\_\_\_
12. \_\_\_\_\_

(attach additional pages as required)

END OF DOCUMENT 00 43 36

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SUPPLEMENT H:  
WAGE RATES REQUIREMENTS STATEMENT



NGB-AEN

DEPARTMENTS OF THE ARMY AND THE AIR FORCE  
NATIONAL GUARD BUREAU  
111 SOUTH GEORGE MASON DRIVE  
ARLINGTON, VA 22204-1382




RECEIVED  
NOV 30 1993 24 NOV 1993

MEMORANDUM FOR SEE DISTRIBUTION FACILITIES & CONSTRUCTION

SUBJECT: Applicability of Davis-Bacon Act

1. The purpose of this memorandum is to clarify the relation of the Davis-Bacon Act to State contracts.
2. All State contracts are exempt from the provisions of the Davis-Bacon Act even though they are funded by 100% Federal funds contributed to the State from the National Guard Bureau. 32 CFR 33.36 (i)(5) requires the use of the Federal Davis-Bacon Act only in cases where it is required by the Federal grant program legislation. Our authorization statues do not require the use of the Davis-Bacon Act. Therefore, the States must follow the applicable State law. Questions should be referred to the State full time Judge Advocate.
3. For further information, please contact Patrick Batt at DSN 327-7911.

FOR THE CHIEF, NATIONAL GUARD BUREAU:

  
DONALD R. FRANKLAND  
LTC EN  
Director of Engineering

DISTRIBUTION

Each TAG (1)

CF:

Each FMO (1)

Each USPFO (1)

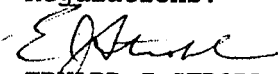
6 JAN 94

MEMORANDUM FOR CW5 JERRY KLINKEFUS

SUBJECT: APPLICABILITY OF DAVIS BACON ACT TO STATE CONTRACT ACTIVITY

1. As a result of my review of the code of IOWA, I have determined that the IOWA state contracting actions which use ARNG appropriations, do not require the Davis Bacon Act clause(s).

2. This is consistent with NGB guidance specific to National Guard appropriation and authorization language, part 31, Code of Federal Regulations.

  
EDWARD J STROBL, LT COL, IA ANG  
STAFF JUDGE ADVOCATE

END OF DOCUMENT 00 43 43

SUPPLEMENT J:  
889 REPRESENTATION FORM

| <b>MICRO-PURCHASE<br/>NATIONAL DEFENSE AUTHORIZATION ACT (NDAA) SECTION 889 REPRESENTATION</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                      |                                                      |                                                                                                    |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|------------------------------------------------------|----------------------------------------------------------------------------------------------------|
| <i>For additional information see: <a href="https://www.acquisition.gov/FAR-Case-2019-009/889_Part_B">https://www.acquisition.gov/FAR-Case-2019-009/889_Part_B</a></i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                      |                                                      |                                                                                                    |
| 1. <input type="checkbox"/> Merchant has an active registration in SAM ( <a href="http://www.sam.gov">www.sam.gov</a> ) <b>and</b> FAR 52.204-26 is dated Oct 2020 (or later)<br><input type="checkbox"/> Merchant is not registered in SAM ( <a href="http://www.sam.gov">www.sam.gov</a> ) <b>or</b> is registered, but FAR 52.204-26 is dated earlier than Oct 2020                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                      |                                                      |                                                                                                    |
| 2. Company Name / Merchant (Offeror)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                      |                                                      | 3. Date                                                                                            |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                      |                                                      |                                                                                                    |
| 4. Company Street Address                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                      | 5. City                                              | 6. State                                                                                           |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                      |                                                      |                                                                                                    |
| 7. Zip Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                      | 8. Owner or Designated Representative Name           |                                                                                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                      |                                                      |                                                                                                    |
| 9. E-mail                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                      | 10. Telephone Number                                 |                                                                                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                      |                                                      |                                                                                                    |
| 11. DUNS Number (if applicable)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 12. Cage Code Number (if applicable) | 13. SAM Registration Expiration Date (if applicable) |                                                                                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                      |                                                      |                                                                                                    |
| 14. Complete the following <a href="#">FAR 52.204-26</a> Representation: <p style="text-align: center;"><b>COVERED TELECOMMUNICATIONS EQUIPMENT OR SERVICES-REPRESENTATION (OCT 2020)</b></p> (a) <i>Definitions.</i> As used in this provision, "covered telecommunications equipment or services" and "reasonable inquiry" have the meaning provided in the clause <a href="#">52.204-25</a> , Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment.<br>(b) <i>Procedures.</i> The Offeror shall review the list of excluded parties in the System for Award Management (SAM) ( <a href="https://www.sam.gov">https://www.sam.gov</a> ) for entities excluded from receiving federal awards for "covered telecommunications equipment or services".<br>(c)(1) <i>Representation.</i> The Offeror represents that it <input type="checkbox"/> does, <input type="checkbox"/> does not provide covered telecommunications equipment or services as a part of its offered products or to the Government in the performance of any contract, subcontract, or other contractual instrument.<br>(2) After conducting a reasonable inquiry for purposes of this representation, the offeror represents that it <input type="checkbox"/> does, <input type="checkbox"/> does not use covered telecommunications equipment or services, or any equipment, system, or service that uses covered telecommunications equipment or services |                                      |                                                      |                                                                                                    |
| Signature of Owner or Designated Representative identified in Block 8 above.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                      |                                                      | <div style="border: 1px solid black; width: 100%; height: 40px; background-color: #e0e0e0;"></div> |
| <b><i>This representation expires on the date in block 13 or one year from the date in block 3, whichever is soonest. Forward any representation modifications/changes to the sender within 30 days.</i></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                      |                                                      |                                                                                                    |
| <b>Additional Disclosure Instructions to Merchant/Offeror (if applicable)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                      |                                                      |                                                                                                    |
| (a) If the Offeror represents in (c)(1) above that, "it <i>does</i> provide covered telecommunications equipment [...]", then the Offeror should go to FAR 52.204-24 -- Representation Regarding Certain Telecommunications and Video Surveillance Services or Equipment, paragraph (e)(1) <i>Disclosures</i> ( <a href="https://www.acquisition.gov/far/part-52#FAR_52_204_24">https://www.acquisition.gov/far/part-52#FAR_52_204_24</a> ) to identify the additional documentation that should accompany this representation when sending it back to the sender.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                      |                                                      |                                                                                                    |
| (b) If the Offeror represents in (c)(2) above that, "it <i>does</i> use covered telecommunications equipment [...]", then the Offeror should go to FAR 52.204-24 -- Representation Regarding Certain Telecommunications and Video Surveillance Services or Equipment, paragraph (e)(2) <i>Disclosures</i> ( <a href="https://www.acquisition.gov/far/part-52#FAR_52_204_24">https://www.acquisition.gov/far/part-52#FAR_52_204_24</a> ) to identify the additional documentation that should accompany this representation when sending it back to the sender.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                      |                                                      |                                                                                                    |

GPC-Merchant 889 Representation v.4

END OF DOCUMENT 00 43 46

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FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR

**IOWA DEPARTMENT OF PUBLIC DEFENSE  
(MILITARY DIVISION)**

**ARMORY BOARD  
IOWA ARMY NATIONAL GUARD**

**STANDARD CONTRACT FOR CONSTRUCTION**

STATE PROJECT: PROJECT NO.: 19083730  
CONTRACT NO.: C32998060

AGREEMENT

made as of the \_\_\_\_\_ day of \_\_\_\_\_ in the year of Two Thousand Twenty-Four (2024).

BETWEEN the Owner: Iowa Department of Public Defense (Military Division)  
Armory Board, Iowa Army National Guard, Adjutant General Chairman  
Camp Dodge, 7105 NW 70<sup>th</sup> Avenue, Johnston, Iowa 50131-1824

and the Contractor:

The Project: S-29 MILLER ARMORY LATRINE ADDITION  
CAMP DODGE, JOHNSTON, IOWA

The Architect: Shive-Hattery  
4125 Westown Parkway, Suite 100  
West Des Moines, Iowa 50266

Amount: \$ \_\_\_\_\_

Payment to be made by: Iowa Department of Public Defense  
State Comptroller Office  
Building 3465 (W-41), Camp Dodge  
7105 NW 70<sup>th</sup> Avenue  
Johnston, Iowa 50131-1824

The Owner and the Contractor agree as follows:

#### **ARTICLE 1 - THE CONTRACT DOCUMENTS**

**1.1** The Contract Documents consists of this Agreement, the Conditions of the Contract (General, Supplementary, and other Conditions), the Drawings, the Specifications, all Addenda issued prior to execution of this Agreement, all other documents listed in this Agreement, and all Modifications issued after execution of this Agreement; these form the Contract, and all are as fully a part of the Contract as if attached to this Agreement or repeated herein. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations or agreements, either written or oral. An enumeration of the Contract Documents, other than modifications, appears in Article 9.

#### **ARTICLE 2 - THE WORK OF THIS CONTRACT**

**2.1** The Contractor shall fully execute the Work described in the Contract Documents, except to the extent specifically indicated in the Contract Documents to be the responsibility of others.

#### **ARTICLE 3 - DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION**

**3.1** DATE OF COMMENCEMENT: The Contractor will be required to commence Work under this Contract by \_\_\_\_\_, after receipt by the Contractor of Notice to Proceed. The Contract Time shall be measured from the date of commencement.

**3.2** SUBSTANTIAL COMPLETION: The Contractor shall achieve Substantial Completion of the entire Work not later than \_\_\_\_\_, subject to adjustments of this Contract Time as provided in the Contract Documents.

#### **ARTICLE 4 - CONTRACT SUM**

**4.1** The Owner shall pay the Contractor in current funds for the performance of the Work, subject to additions and deductions by Change Order as provided in the Contract Documents, the Contract Sum of

\$ \_\_\_\_\_

**4.2** The Contract Sum is determined as follows:

BASE BID: \$ \_\_\_\_\_

ALTERNATE NO. 1: \$ \_\_\_\_\_

#### **ARTICLE 5 - PROGRESS PAYMENTS**

**5.1** Based upon Applications for Payment submitted to the Architect by the Contractor and Certificates for Payment issued by the Architect, the Owner shall make progress payments on account of the Contract Sum to the Contractor for the period ending on the last day of the month as provided in the Contract Documents and as follows:

**5.1.1** Not later than 30 days following the date the Application for Payment is received by the Owner's Representative, ninety-five percent (95%) of the portion of the Contract Sum properly

allocable to labor, materials, and equipment incorporated in the Work and ninety-five percent (95%) of the portion of the Contract Sum properly allocable to materials and equipment suitably stored at the Site or at some other location agreed upon in writing, for the period covered by the Application for Payment, less the aggregate of previous payments made by the Owner, and upon Substantial Completion of the entire Work, a sum sufficient to increase the total payments to ninety-five percent (95%) of the Contract Sum, less such amounts as the Architect shall determine for all incomplete Work, retainage applicable to such work and unsettled claims as provided in the Contract Documents.

**5.2** Application for Payment: One (1) copy shall be submitted to the Architect via email in pdf format on AIA Document G702 - 1992, Application and Certificate for Payment, supported by AIA Document G703 – 1992, Continuation Sheet.

**5.3** Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due in accordance with Section 573.12, Code of Iowa.

## **ARTICLE 6 - FINAL PAYMENT**

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

**6.1.1** The Contractor has fully performed the Contract except for the Contractor's responsibility to correct Work as provided in Subparagraph 12.2.2 of the General Conditions and to satisfy other requirements, if any, which extend beyond final payment;

**6.1.2** all closeout documents required to be submitted with the final Application have been received by the Architect; and

**6.1.3** a final Certificate for Payment has been issued by the Architect.

**6.2** The Owner's final payment to the Contractor shall be made thirty days after the issuance of the Owner's Letter of Final Acceptance.

## **ARTICLE 7 - MISCELLANEOUS PROVISIONS**

**7.1** Terms in this Agreement which are defined in the Conditions of the Contract shall have the meanings designated in those Conditions.

**7.2** Where reference is made in this Agreement to a provision of the General Conditions or another Contract Document, the reference refers to that provision as amended or supplemented by other provisions of the Contract Documents.

## **ARTICLE 8 - FUNDING**

**8.1** Award of this contract is dependent on receiving requested Federal and/or State funding. If such funding is not received within the sixty (60) day bid guarantee after the date of receiving bids, all rights and obligations under this agreement are considered null and void.

## **ARTICLE 9 - ENUMERATION OF THE CONTRACT DOCUMENTS**

**9.1** The Contract Documents, except for Modifications issued after execution of this Agreement, are enumerated as follows:

1. This executed Agreement
2. Any issued Addendums
3. Performance and Payment Bond
4. Application and Certificate for Payment
5. General Conditions of the Contract for Construction
6. Supplementary and other Conditions
7. Certificate(s) of Insurance
8. Certificate of Substantial Completion
9. General Requirements (Division 1)
10. Technical Specifications (All other Divisions)
11. Drawings

**STATE OF IOWA:**

Department of Public Defense (Military Division)  
Armory Board, Iowa Army National Guard

**CONTRACTOR:**

By \_\_\_\_\_

\_\_\_\_\_  
(Name Typed)

\_\_\_\_\_  
(Title)

\_\_\_\_\_  
Iowa National Guard  
(Address)

\_\_\_\_\_  
Camp Dodge, 7105 NW 70<sup>th</sup> Avenue

\_\_\_\_\_  
Johnston, Iowa 50131-1824

By \_\_\_\_\_

(Contractor)

\_\_\_\_\_  
(Name Typed)

\_\_\_\_\_  
(Title)

\_\_\_\_\_  
(Address)

Phone No.: \_\_\_\_\_

FAX No.: \_\_\_\_\_

Federal ID No.: \_\_\_\_\_

IA Registration No.: \_\_\_\_\_

NOTE: If the Contractor is a corporation, the following witness signatures are not required, but the annexed Certificate of Corporate Authority must be completed. Type or print names under all witness signatures.

IN WITNESS WHEREOF, the parties hereto have executed this Contract as of the \_\_\_\_\_ day of \_\_\_\_\_, 2024.

(Date to be completed by Owner upon receipt of all signatures.)

\_\_\_\_\_  
State of Iowa - Witness Signature

\_\_\_\_\_  
Printed Name

\_\_\_\_\_  
Contractor – Witness Signature

\_\_\_\_\_  
Printed Name

**CERTIFICATE OF CORPORATE AUTHORITY**

I, \_\_\_\_\_ certify that I am the  
(typed name of corporate officer other than person signing Contract)  
\_\_\_\_\_ of the corporation named as Contractor  
(typed corporate office of person signing above)  
herein; that \_\_\_\_\_, who signed this Contract on behalf of  
(typed name of person who signed Contract)  
the Contractor, was then \_\_\_\_\_ of said corporation;  
(typed position of person signing Contract)  
that said Contract was duly signed for and in behalf of said corporation by authority of its governing body,  
and is within the scope of its corporate powers.

**AFFIX YOUR CORPORATE SEAL TO THE BOTTOM OF THIS FORM IF ONE EXISTS**

END OF DOCUMENT 00 52 00

DOCUMENT 00 61 00

PERFORMANCE AND PAYMENT BOND

AIA Document A312 – Performance and Payment Bond, 2010 Edition shall be utilized for this project and is hereby a part of the Specifications and Contract Documents as if it were bound herein.

Copies and samples for preview of the document can be obtained online from:  
<https://www.aiacontracts.org/purchase>.

END OF DOCUMENT 00 61 00

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DOCUMENT 00 62 10

APPLICATION AND CERTIFICATE FOR PAYMENT

AIA Document G702 (1992) – Application and Certificate for Payment Form, supported by AIA Document G703 (1992) Continuation Sheet shall be utilized for this project and is hereby a part of the Specifications and Contract Documents as if it were bound herein.

Copies and samples for preview of the document can be obtained online from:  
<https://www.aiacontracts.org/purchase>.

Note: Electronically submit Applications for Payment to the Architect or Engineer per the Supplementary Conditions.

END OF DOCUMENT 00 62 10

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DOCUMENT 00 72 00

GENERAL CONDITIONS

AIA Document A201-2007 – General Conditions of the Contract for Construction, hereafter referred to as General Conditions, forms the General Conditions for this Construction Contract and is hereby a part of the Specifications and Contract Documents as if it were bound herein.

Copies and samples for preview of the document can be obtained online from:  
<https://www.aiacontracts.org/purchase>.

END OF DOCUMENT 00 72 00

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SUPPLEMENTARY CONDITIONS

The following supplements modify the General Conditions of the Contract for Construction, AIA Document A201-2007. Where a portion of the General Conditions is modified or deleted by these Supplementary Conditions, the unaltered portions of the General Conditions shall remain in effect.

Unless noted otherwise, all references are to Articles and Sections of AIA Document A201-2007, General Conditions of the Contract for Construction.

See also related topics in Division 1 – General Requirements for additional requirements.

**REFERENCE ARTICLE 1 - GENERAL PROVISIONS**

1. Reference Section 1.1.1:

A written order for a minor change in the Work may also be issued by the Owner's Construction Manager as provided in Section 2.1.1.5 of these Supplementary Conditions.

2. Reference Section 1.1.2; Add Sections:

**1.1.2.1** All contracts awarded by the State are subject to access by the State, National Guard Bureau, The Comptroller General of the United States, or any of their duly authorized representatives. This includes books, documents, papers, etc., and records of the Contractor which are directly pertinent to that specific contract for the purpose of making audits, examinations, excerpts, and transcriptions.

**1.1.2.2** Regulations for proper operation and administration of construction contracts: Code of Federal Regulations (CFR), provide solicitation provisions and contract clauses that pertain to this Project. A copy of these regulations are not bound herein, but are included by reference. Copies may be reviewed in the State Comptroller Office, Building 3465 (W-41), Camp Dodge, 7105 NW 70th Avenue, Johnston, Iowa 50131-1824.

3. Reference Section 1.2.1; Add Section:

**1.2.1.1** In the event of conflicts or discrepancies among the Contract Documents, interpretations will be based on the following priorities:

- .1 Modifications
- .2 The Agreement.
- .3 Addenda, with those of later date having precedence over those of earlier date.
- .4 The Supplementary Conditions.
- .5 The General Conditions of the Contract for Construction.
- .6 Division 1 of the Specifications.
- .7 Drawings and Divisions 2-49 of the Specifications.
- .8 Other documents specifically enumerated in the Agreement as part of the Contract Documents.

In the case of conflicts or discrepancies between Drawings and Division 2-49 of the Specifications or within or among the Contract Documents and not clarified by Addendum, the Architect will determine which takes precedence in accordance with Sections 4.2.11, 4.2.12, and 4.2.13. In instances where conflict or discrepancy involves quality or quantities, the better quality or greater quantity of work will take precedence.

4. Reference Section 1.5; Delete Section 1.5.1 and substitute the following:

**1.5.1** All Drawings, Specifications, and other Instruments of Service, and copies thereof, including those in electronic form, are and shall remain the Owner's property with the exception of one contract set for each party to the Contract.

5. Reference Section 1.5; Delete Section 1.5.2 and substitute the following:

**1.5.2** The Drawings, Specifications and other Instruments of Service prepared by the Owner or Architect and Architect's consultants, and copies thereof furnished to, or made by, the Contractor, are for use solely with respect to this Project. They are not to be reproduced or used by the Contractor or any Subcontractor, Sub-subcontractor or material or equipment supplier on other projects or for additions to this Project outside the scope of Work without the specific written consent of the Owner.

## **REFERENCE ARTICLE 2 - OWNER**

6. Reference Section 2.1.1; Add Sections:

**2.1.1.1** Unless otherwise indicated, the term Owner where referred to in the Contract Documents shall mean The Armory Board for the Iowa Army National Guard – Adjutant General Chairman.

**2.1.1.2** The Owner's Representative shall be the State Contracting Officer for the Iowa Army National Guard – State Comptroller Office, executing the Contract on behalf of the State and any other officer or civilian employee properly designated Contracting Officer.

The Owner's Representative hereby authorizes the following persons to represent the Owner in the fulfillment of their respective duties as hereinafter described:

1. The Architect
2. The Owner's Construction Manager

### **2.1.1.3** Duties of the Owner's Representative

1. The Owner's Representative is authorized to act on behalf of the Owner and shall fulfill the duties, rights and obligations of the Owner under the Contract Documents.
2. The Owner's Representative will prepare and initiate Contract Change Orders in accordance with Section 7.2.
3. The Owner's Representative will have authority to reject Work that does not conform to the Contract Documents in accordance with Section 4.2.6 after review with the Architect.

### **2.1.1.4** Duties of the Architect

1. The Architect is as defined in Section 4.1.1 and shall provide administration of the Contract as described in the Contract Documents.

### **2.1.1.5** Duties of the Construction Manager

1. The Owner's Construction Manager shall act on behalf of the Owner in all daily actions and communication in accordance with Section 4.2.4.
2. The Owner's Construction Manager shall be responsible for communication and coordination of concerns of the Project to and from all persons within the Owner's organization.
3. The Owner's Construction Manager shall observe the progress of the Work and report any observed deviations from the Contract Documents to the Architect for a determination. The Owner's Construction Manager is not authorized to permit deviations from the Contract Documents.

4. The Owner's Construction Manager shall assist in coordinating the Contractor's operations with those of the Owner. The Owner's Construction Manager, however, shall not perform any duties for the Contractor.
5. The Owner's Construction Manager shall have the authority to, and may issue an order for a minor change in the Work in accordance with Section 7.4 after review with the Architect.

7. Reference Section 2.2; Delete Section 2.2.5 and substitute the following:

**2.2.5** No copies of the Contract Documents will be furnished by the Owner to the Contractor with the exception of any complete sets of Bidding Documents returned to the issuing entity designated in the Advertisement for Bids. Additional reproductions may be made by the Contractor pursuant to Section 1.5.2.

8. Reference Section 2.2; Add Section:

**2.2.6** The Owner will procure and bear costs of Special Inspections if required by applicable building codes for the project. See Section 13.5.1.1 of these Supplementary Conditions for additional requirements.

### **REFERENCE ARTICLE 3 - CONTRACTOR**

9. Reference Section 3.1.1; Add Section:

**3.1.1.1** Under Chapter 91C of the Iowa Code (1989), any construction contractor performing work in Iowa (including out-of-state contractors) is required to register with the Iowa Division of Labor. (See Article 11 of the Instructions to Bidders).

10. Reference Section 3.2.1; Add Section:

**3.2.1.1** The Contract is executed as set forth in the Instructions to Bidders.

11. Reference Section 3.2; Add Sections:

**3.2.5** Figured dimensions on the Drawings shall be used in preference to scaling the Drawings. If Contractor scales Drawings, dimensions so obtained shall be the sole responsibility of the Contractor.

**3.2.6** Where the Work of the Contractor is affected by finish dimensions of manufacturer's equipment, the finish dimension shall be determined by the Contractor, who shall assume the responsibility for proper coordination.

**3.2.7** If in the opinion of the Contractor it is not reasonably possible to provide first-class Work by following the procedures and requirements detailed or specified in the Contract Documents, the Contractor shall make a written request for interpretation to the Architect outlining the conditions and concerns. The Contractor shall not proceed with the portion of the Work in question until a response has been received from the Architect. The Architect shall respond with reasonable promptness.

12. Reference Section 3.3; Add Sections:

**3.3.4** The Contractor shall not be relieved of obligations to perform the Work in accordance with the Contract Documents either by activities or duties performed by the Owner or Architect in the Administration of the Contract, or by tests, inspections or approvals required or performed by persons other than the Contractor.

**3.3.5** The Contractor shall perform the Work so as to cause a minimum of inconvenience to and interruption of the Owner's operations. Any and all interruptions of the operations of the Owner necessary for the performance of the Work shall be noted in the progress schedule and the Contractor shall additionally give the Owner sufficient advance notice of such interruptions as to allow the Owner time to adjust its operations accordingly. Contractor's failure to give the Owner timely notice of such intentions shall place the responsibility for any resulting delays, additional costs, or other liabilities solely with the Contractor.

**3.3.6** Prior to commencing the Work under the Contract, the Contractor shall contact all affected entities supplying utilities and arrange for the moving of such utility installations as is necessary for the performance of the Work. It shall be the responsibility of the Contractor to coordinate the Work with that of the affected entities in such a manner as to cause the least possible interference.

13. Reference Section 3.4.1; Add Section:

**3.4.1.1** By virtue of statutory authority, give preference to Iowa domestic labor and materials in the execution of the Work, in accordance with provisions of Chapter 73, Code of Iowa, 1962, and amendments including Senate File 2160, dated April 11, 1984. Machinery, equipment, materials and articles installed or used without such approval are at risk of subsequent rejection.

14. Reference Section 3.4.2; Add Section:

**3.4.2.1** After the Contract has been executed, the Owner and Architect will consider a formal request for the substitution of products in place of those specified only under the conditions set forth in the General Requirements (Division 1 of the Specifications).

15. Reference Section 3.5; Add Sections:

**3.5.1** This warranty shall be for the period specified in the Contract Performance and Payment Bond unless a longer period is required elsewhere in the Contract Documents for certain portions of Work, in which case the longer period shall govern.

**3.5.2** The general warranty provided herein is in addition to and not in limitation of the Contractor's obligations under Section 12.2 and any other warranty or remedy provided by law or by the Contract Documents.

**3.5.3** The Contractor will furnish maintenance and 24-hour call-back service for the equipment provided and/or installed by the Contractor for a period of 3 months after the date of Substantial Completion. This maintenance and service will include repair and regular examinations of the equipment and installation by competent and trained employees of the Contractor, and all necessary adjustments, greasing, oiling, cleaning, supplies and parts required to keep the equipment in proper operations, except such parts made necessary due to misuse, accidents, or negligence not caused by the Contractor, Subcontractors, or Sub-subcontractors.

16. Reference Section 3.6; Delete Section and substitute the following:

**3.6 TAXES**

**3.6.1** This project is TAX EXEMPT.

**.1** The Iowa Department of Public Defense (DPD) is a registered Designated Exempt Entity (DEE) with the Iowa Department of Revenue (IAC chapter 701 - 19.12.) As a DEE, all contractors that are awarded a contract with the Department are issued a tax-exempt certificate for each project that allows the purchase of building materials or withdraw of inventory without incurring a state sales tax. This special exemption certificate would also allow a manufacturer of building materials to consume materials in the performance of a construction contract with a designated exempt entity, without owing tax on the fabricated cost of those materials.

**.2** All Contractors responding to a DPD request for proposal should take this in to consideration when figuring out the cost of materials in the project proposal. Refunds for



state sales tax on building materials will not need to be considered in the proposal and are discouraged. For more information please refer to:

<https://tax.iowa.gov/construction-contracts-designated-exempt-entities>

**.3** If the contract includes machinery or equipment, the contractor must purchase it for resale and give the supplier a regular exemption certificate (issued from DPD). The contractor should not charge sales tax on machinery and equipment sold to DPD.

17. Reference Section 3.7.2; Add Section:

**3.7.2.1** Compliance with the above shall not preclude the establishment of and compliance with non-conflicting higher standards as may be specified or indicated elsewhere in the Contract Documents.

18. Reference Section 3.7.4; Add Sections:

**3.7.4.1** The conditions described in the first sentence include any conditions which the Contractor will consider as the basis for a claim for extra compensation and include but are not limited to materials containing asbestos, polychlorinated biphenyl (PCB), or other hazardous materials.

**3.7.4.2** By failing to give notice within the time allotted above, the Contractor waives all rights for extra compensation of any kind arising out of the concealed or unknown conditions.

19. Reference Section 3.7.5; Modify Section by adding the underlined words, so that the section now reads as follows:

**3.7.5** If, in the course of the Work, the Contractor knowingly encounters and recognizes human remains, burial markers, archeological sites or previously undelineated wetlands not indicated in the Contract Documents, the Contractor shall immediately suspend any operations that would affect them and shall notify the Owner and Architect. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume the operations. The Contractor shall continue to suspend such operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features. Requests for adjustments in the Contract Sum and Contract Time arising from the existence or good faith belief of such existence of such remains or features may be made as provided in Article 15.

20. Reference Section 3.7; Add Sections:

**3.7.6** See Section 10.7 of these Supplementary Conditions for Stormwater Pollution Prevention Plan and Permit requirements.

**3.7.7** The Contractor must recognize mandatory standards and policies relating to energy efficiency contained in the State Energy Conservation Plan issued in compliance with the Energy Policy and Conservation Act (PL 94-163).

21. Reference Section 3.9.1; Modify the first sentence by adding the underlined words, so that the first sentence now reads as follows:

**3.9.1** The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work (including work performed by subcontractors).

22. Reference Section 3.9; Add Section:

**3.9.4** The superintendent shall organize and coordinate scheduling of the Work and shall review and coordinate Work between the trades/Subcontractors.

23. Reference Section 3.10.2; Delete the last sentence.

24. Reference Section 3.13; Add Sections:

**3.13.1** The Contractor shall provide any additional facilities or areas beyond those areas permitted at the site as required for construction operations or storage of materials at no additional cost to the Owner.

**3.13.2** The Contractor shall take all necessary precautions to prevent damage to pipes, conduits, and other underground structures. The Contractor shall protect from disturbance or damage all monuments and property marks until an authorized agent of the Owner has witnessed or otherwise referenced their location and the Contractor shall not remove such marks or monuments until directed.

25. Reference Section 3.15; Delete Sections 3.15.1 and 3.15.2 and substitute the following:

**3.15.1** The Contractor shall at all times keep the site of the Work and adjacent premises as free from materials, debris, rubbish and trash as practical and shall remove same from any portion of the site and adjacent premises if, in the opinion of the Owner, such materials, debris, rubbish or trash constitute a nuisance or are in any way objectionable to the public. The Contractor shall be responsible for the timely removal of dirt accumulations or any other debris on access roads and public streets and highways resulting from the Contractor's operations.

**3.15.2** At the completion of the Work, the Contractor shall remove all materials, implements, staging, piling falsework, debris and rubbish connected with or caused by operations for such Work immediately upon completion of that Work and shall leave the premises in perfect condition insofar as affected by the Work under the Contract. Fires for disposal of rubbish on the site are prohibited.

**3.15.3** If the Contractor should fail to clean up the premises as provided in the Contract Documents, the Owner, after giving the Contractor forty-eight hours notice, may do so and Owner shall be entitled to reimbursement from the Contractor.

26. Reference Section 3.16; Add Section:

**3.16.2** The Contractor shall furnish the Owner and Architect all necessary assistance to facilitate inspections throughout the process of manufacture or construction, or for the examination of any materials entering into the Work, or for any other purpose required in the discharge of the Owner or Architect's duties.

27. Reference Section 3.18; Add Sections:

**3.18.3** The obligations of the Contractor under Section 3.18 shall not extend to the liability of the Owner and its consultants, its agents or employees arising out of: (1) the preparation or approval of maps, Drawings, opinions, reports, surveys, Contract Change Orders, designs or specifications, or (2) the giving of or failure to give directions or instructions by the Owner, its agents or employees providing such giving or failure to give directions or instructions is the primary cause of the injury or damage.

**3.18.4** The Contract Documents define claims, damage, losses, and expenses as, but do not limit them to: (1) injury or damage consequent upon the failure of or use or misuse by the Contractor, its Subcontractors, agents, servants, or employees, of any hoist, rigging, blocking, scaffolding, or any and all other kinds of items of equipment furnished or loaned by the Owner; (2) all attorneys' fees and costs incurred in defense of the claim or in bringing an action to enforce the provision of this indemnity or any other indemnity contained in the Contract Documents; and (3) all costs, expenses, lost time, opportunity costs, etc., incurred by the party being indemnified or its employees, agents, or consultants.

**3.18.5** The indemnification obligations of the Contractor under this Contract does not extend to the liability of the Owner, any Owner's consultants, or their agents, consultants, or employees arising out of their own negligence.

**3.18.6** If trade unions perform the Work or any portion of the Work, the Contractor shall make all necessary arrangements to reconcile without delay, damage or cost to the Owner and its consultants, any conflict between the Contract Documents and any agreements or regulations of any kind at any time in force among members or councils which regulate or distinguish what activities are not included in the work of any particular trade. If this affects the progress of the Work in finishing or installing any items or materials or equipment required under the Contract Documents because of the conflict involving any such agreement or regulation, the Owner or its consultants may require that the Contractor provide other material or equipment of equal kind and quality at no additional cost to the Owner.

#### **REFERENCE ARTICLE 4 - ADMINISTRATION OF THE CONTRACT**

28. Reference Section 4.2.2; Add Section:

**4.2.2.1** The presence or absence of an Owner's Representative or the Architect on the site for the purpose of inspection shall not relieve the Contractor from any obligations to perform the Work in accordance with the requirements of the Contract Documents.

29. Reference Section 4.2.6:

The Owner will also have the authority to reject Work as provided in Section 2.1.1.3 of these Supplementary Conditions.

#### **REFERENCE ARTICLE 5 - SUBCONTRACTORS**

30. Reference Section 5.3; Add Sections:

**5.3.1** Such agreements between the Contractor and each Subcontractor (and where appropriate between Subcontractors and Sub-subcontractors) shall also contain provisions that:

.1 require submission to the Contractor of applications for payment under each subcontract to which the Contractor is a party, in reasonable time to enable the Contractor to apply for payment in accordance with Article 9;

.2 require that all Claims for additional costs, extensions of time, damages for delays or other claims with respect to subcontracted portions of the Work shall be submitted to the Contractor (via any Subcontractor or Sub-subcontractor where appropriate) in sufficient time so that the Contractor may comply in the manner provided in the Contract Documents for like Claims by the Contractor against the Owner;

.3 waive all rights the contracting parties may have against one another for damages caused by fire or other perils covered by property insurance described in Article 11, except such rights as they may have to the proceeds of such insurance held by the Owner as trustee;

.4 inform Subcontractors of their rights under Chapter 573, Code of Iowa; and

.5 obligate each Subcontractor to consent specifically to the provisions of Section 5.2.

**5.3.2** In accordance with Section 573.12 of the Code of Iowa, the Contractor will make prompt payments to Subcontractors for satisfactory performance of the Work.

#### **REFERENCE ARTICLE 6 - CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS**

31. Reference Section 6.1.3; Add Section:

**6.1.3.1** The Contractor shall be responsible for furnishing accurate information for and participating in the development of a realistic Project schedule.

32. Reference Section 6.2.4; Add Section:

**6.2.4.1** Should the Contractor cause damage to the Work or property of any separate contractor or be the cause of delay or failure to perform, the Contractor shall upon due notice promptly attempt to settle with such other contractor by agreement, or otherwise to resolve the dispute. If such separate contractor sues or initiates an arbitration proceeding against the Owner on account of any damage alleged to have been caused by the Contractor, the Owner shall notify the Contractor who shall defend such proceedings, and if any judgment or award against the Owner arises therefrom the contractor shall pay or satisfy it and shall reimburse the Owner for all attorneys' fees and court or arbitration costs which the Owner has incurred.

33. Reference Section 6.2; Add Sections:

**6.2.6** Claims and other disputes and matters in question between the Contractor and separate contractors are subject to the provisions of Section 15.3 and 15.4 provided the separate contractor has reciprocal obligations.

**6.2.7** The Contractor shall execute all Work in such manner and in such order, or procedure, as will permit the commencement and carrying on of the Work of the Owner and of separate contractors with the least interference possible using a reasonable procedure whenever it is necessary or desirable to execute such work either simultaneously with the Work under Contract, or otherwise. To this end the Contractor shall cooperate and assist the Owner and separate contractors in every reasonable way, and shall interfere as little as possible with their Work. The Contractor shall move, free of charge, the Contractor's plant equipment and materials or any part of same whenever the Owner considers it reasonable and necessary for the work of the Owner or separate contractors.

## **REFERENCE ARTICLE 7 - CHANGES IN THE WORK**

34. Reference Section 7.1.2; Add Section:

**7.1.2.1** The Owner's Construction Manager shall also have authority to act alone in issuing an order for a minor change in the Work as provided in Section 2.1.1.5 of these Supplementary Conditions.

35. Reference Section 7.1; Add Sections:

**7.1.4** The pricing of changes in the Work which result in an adjustment to the Contract Sum (excepting Alternate Bids, see Section 7.1.5) shall be limited to the Contractor's direct expenses as defined in Sections 7.3.7.1 through 7.3.7.5, plus the applicable percentage of overhead and profit subject to the following limits:

.1 Fifteen percent (15%) maximum mark-up for Work directly performed by employees of the Contractor, Subcontractor, or Sub-subcontractor.

.2 Five percent (5%) maximum Contractor's mark-up for Work performed or passed through by a Subcontractor and passed through to the Owner by the Contractor.

.3 Five percent (5%) maximum Subcontractor's mark-up for Work performed by a Sub-subcontractor and passed through to the Owner by the Subcontractor and Contractor.

.4 The maximum allowable mark-up is twenty-five percent (25%) passed through to the Owner by the Contractor under any circumstances.

**7.1.5** The pricing of changes in the Work that add work already bid as an Alternate which have expired, shall adhere to the following guidelines:

.1 Direct material and labor costs associated with the alternate shall be enumerated in the Request for Change and highlight the original cost, the current cost, the difference, and the reason for the difference.

.2 The Contractor may add up to 15% mark-up for the difference between the original direct material and labor costs and the current material and labor costs only.

.3 The contractor may add to the total a 2% mark-up for increased bonds and insurance costs.

**7.1.6** Prices shall include all subcontracts and shall be itemized as follows:

.1 Labor costs shall indicate trade, hourly rate, man hours, and total costs.

.2 Materials, supplies and equipment costs shall indicate unit cost, quantity, and total cost for each item.

.3 Machinery and equipment costs shall indicate machinery or equipment type, number of each, hourly rate, and total cost for each item.

**7.1.7** The Contractor shall be allowed no additional compensation for any costs, fees or expenses incurred in performing services already required by the Contract for Construction, and shall not be entitled to additional reimbursement for its home office, other non-job site or indirect overhead expenses, or tools necessary for construction.

**7.1.8** Any request for time extension as a result of the Change in Work must be justified and presented in adequate detail showing that the proposed change will delay the final Contract completion date.

**7.1.9** Contractor shall not apply sales, consumer, use and similar tax charges incurred for material purchases in charges toward the overhead and profit percentage.

**7.1.10** The following definitions shall be used in establishing process for Changes in Work:

.1 Direct expense is the Contractor's actual cost of any item that is easily defined as a required item for the completion of his Contract obligation.

.2 Overhead is a business expense created by the Project but not necessarily a direct part of that portion of the Work involved.

.3 Profit is the compensation accruing to the Contractor for the assumption of risk in a business enterprise.

36. Reference Section 7.2.1; Delete Section and substitute the following:

**7.2.1** A Change Order is a written instrument prepared by the Owner and signed by the Owner and Contractor stating their agreement upon all of the following:

37. Reference Section 7.4; Add Section:

**7.4.1** The Owner's Construction Manager shall also have authority to issue an order for a minor change in the Work as provided in Section 2.1.1.5 of these Supplementary Conditions.

## **REFERENCE ARTICLE 8 - TIME**

38. Reference Section 8.2; Add Section:

**8.2.4** In the event the Contractor fails to maintain the schedule, including accepted revisions, the Contractor shall promptly, at no additional cost to the Owner, increase work forces, increase hours, and/or initiate revisions to means and methods of construction as required to make up lost time and complete the Work in accordance with the construction schedule.

## REFERENCE ARTICLE 9 - PAYMENTS AND COMPLETION

39. Reference Section 9.3.1; Add the following sentence to Section 9.3.1:

The Form of Application for Payment shall be a current authorized edition of AIA Document G702 – 1992, Application and Certificate for Payment, supported by a current authorized edition of AIA Document G703 – 1992, Continuation Sheet. One copy of each Application for Payment shall be submitted electronically in .pdf format via email to the Architect or, if applicable, uploaded to the project website for each progress payment.

40. Reference Section 9.3.1; Add Sections:

**9.3.1.3** Applications for Payment shall be submitted once a month.

**9.3.1.4** The Owner will withhold until final payment, retainage in an amount consistent with the provisions of Section 573.12, 573.13, and 573.14 of the Code of Iowa.

41. Reference Section 9.5.1; Add Section:

**9.5.1.8** third party claims filed pursuant to Chapter 573 of the Iowa Code.

42. Reference Section 9.5.3; Delete section in its entirety.

43. Reference Section 9.6.4; Delete the first two sentences.

44. Reference Section 9.8.5; Delete the second sentence and substitute the following:

Upon such acceptance and consent of surety, if any, the Owner shall make payment sufficient to increase the total payments to ninety-five percent (95%) of the Contract Sum, less such amounts as the Architect shall determine for incomplete Work and unsettled claims.

45. Reference Section 9.10.1; Add Section:

**9.10.1.1** Issuance of a letter of Final Acceptance by the Owner shall establish the commencement of the thirty-day period during which the Owner retains final payment of the balance due under the Contract under Iowa law and per provisions of this Agreement. If at the end of such thirty-day period, claims are on file with the Owner, the Owner will withhold a sum equal to double the total amount of claims on file or five percent (5%) of the Contract price, whichever is less, until such claims are released or otherwise adjudicated. The Owner will issue a letter of Final Acceptance to the Contractor upon receipt of the Final Certificate for Payment from the Architect.

46. Reference Section 9.10.2; Add Sections:

**9.10.2.1** The Owner will not make final payment until the Contractor has performed final cleanup in accordance with Section 3.15

**9.10.2.2** See Division 1 – General Requirements for items to be submitted with the final Application for Payment. The Architect will not issue a final Certificate of Payment until all items indicated are submitted:

## REFERENCE ARTICLE 10 - PROTECTION OF PERSONS AND PROPERTY

47. Reference Section 10.1; Add Sections:

**10.1.1** Accident Prevention: The safety provisions of all applicable laws, building and construction codes shall be observed. Machinery, equipment and all hazards shall be guarded or eliminated in accordance with the safety provisions of the latest edition of the Manual of Accident Prevention in Construction, published by the Associated General Contractors of America, to the extent that such provisions are not in contravention of applicable laws.

**10.1.2** The Work shall be governed by applicable provisions of the general law, including the latest amendments of the following:

1. William-Steiger Occupational Safety & Health Act of 1970, Public Law 91-596.
2. Part 1910 – Occupational Safety & Health Standards, Chapter XVII of Title 29, Code of Federal Regulations.
3. Part 1518 –Safety and Health Regulations for Construction, Chapter XIII of Title 29, Code of Federal Regulations.

**10.1.3** The Contractor is responsible for conducting a safety program and/or precautions on the project site that assures work on the site is conducted in accordance with all guidelines and requirements of OSHA and other applicable laws, building and construction codes, and sound construction practice. The Contractor shall prepare, implement and enforce a project safety plan for the purpose of maintaining a site where work is conducted in a safe manner. A copy of the safety plan shall be maintained on the site at all times.

48. Reference Section 10.2; Add Sections:

**10.2.9** The Contractor must comply with provisions of Section 88.6(1) of the Code of Iowa pertaining to Occupational Safety and Health Administration (OSHA) entrance and inspections which states that the State Labor Commissioner or State Labor Commissioner's representative upon presenting appropriate credentials to the Owner, operator, or agent in charge, is authorized:

- .1 To enter without delay and at reasonable times a factory, plant, establishment, construction site, or other area, work place, or environment where work is performed by an employee of an employer; and
- .2 To inspect and investigate during regular working hours and other reasonable times, and within reasonable limits, and within a reasonable manner, any such place of employment and all pertinent conditions, structures, machines, apparatus, devices, equipment, and materials therein, and to question privately any such owner, operator, agent, or employer.

49. Reference Section 10.3.1; Add Section:

**10.3.1.1** The Contractor is not required pursuant to Article 7 to perform without consent any work relating to asbestos or polychlorinated biphenyl (PCB).

50. Reference Section 10.3; Add Sections:

**10.3.7** Lamps, bulbs and ballasts indicated to be removed by the Contractor, and not indicated to be reused on the project, can be salvaged by the Owner or the Contractor. If not salvaged, the Contractor shall pay any required fees and ensure proper disposal as universal waste (ballasts labeled as "PCB Free" can be disposed as solid waste).

**10.3.8** All self-luminous or photo-luminescent (radioactive tritium) exit signs shown to be removed by the Contractor shall be removed without damage and turned over to the Owner for disposal.

**10.3.9** The Contractor shall not use asbestos-containing products or materials. Requests for exceptions shall be forwarded by the Contractor to the Owner for approval by the Environmental Branch of the Directorate of Installation Management.

**10.3.10** The Contractor shall not knowingly remove, damage or disturb asbestos-containing materials unless required by the project's plans and specifications. Any asbestos abatement identified in the Contract Documents as the responsibility of the Contractor must be performed by properly trained and certified personnel in accordance with all environmental and worker safety regulations.

51. Reference Section 10.3.1; Add Section:

**10.3.1.1** The Contractor is not required pursuant to Article 7 to perform without consent any work relating to asbestos or polychlorinated biphenyl (PCB).

52. Reference Article 10; Add Sections:

**10.5 IOWA HAZARDOUS CHEMICAL RISKS RIGHT TO KNOW LAW:**

**10.5.1** Owner's Responsibility. Upon request, the Owner will provide to the Contractor a list of known hazardous chemicals within the Project Site to which their employees may be exposed and suggestions for appropriate protective measures.

**10.5.2** Contractor's Responsibility. Contractor must inform his/her employees of the Iowa Hazardous Chemical Risks Right to Know Law.

**10.5.3** The Contractor must provide to the Owner a list of known hazardous chemicals that they anticipate using on site as well as other pertinent information relating to employee protection. Contractor's Material Safety Data Sheets (MSDS) must be available to the Owner upon request.

**10.7 POLLUTION PREVENTION PROCEDURES**

**10.7.1** The following pollution prevention procedures shall apply to all Contractors working on Iowa Army National Guard projects:

.1 Spill Prevention and Response: The Contractor shall take adequate precautions to prevent spills of hazardous chemicals, oils, and fuels. The Contractor shall have procedures in place to immediately clean up all spills that could occur on the job site or during transportation to and from the job site. Expenses incurred in the spill cleanup shall belong to the Contractor. Specifically:

- .a When liquid hazardous chemicals, oils, or fuels are stored on the job site, the contractor shall provide secondary containment, for containers with 55 gallon capacity or greater, equal to or greater than 110% of the volume of the single largest container.
- .b The Contractor shall notify the Iowa Army National Guard Environmental Branch in the event of a spill of chemicals, oils or fuels. The Contractor must have sufficient resources on the work site to clean up a spill. All workers at the site shall know whom the Contractor point of contact is and what they are to do in the event of a spill.
- .c The point of contact for the Environmental Branch is:

Shannan Garretson, Environmental Program Manager  
Building 3535 (B-61), Camp Dodge  
7105 NW 70th Avenue  
Johnston, Iowa 50131-1824  
Phone: (515) 252-4557  
Non-duty Hours Cell Phone (515) 249-5847

.d The Contractor must notify the Iowa Department of Natural Resources and the local sheriff's office of a hazardous substance spill that meets the definition of a "hazardous condition" as defined in the Iowa Administrative Code. Iowa law requires reporting as soon as possible but not later than six hours. Spills meeting the criteria of a "reportable spill" will also require notification of the National Response Center.

**10.7.4** Storm Water Pollution Prevention Plans and Permits:

- .1 A Storm Water Pollution Prevention Plan and a discharge permit will be required for construction activities resulting in one acre or more soil disturbance.
- .2 The Iowa Army National Guard's Director of Installation Management Environmental Branch shall obtain the permit.



.3 The General Contractor, and each subcontractor that has a responsibility described in the plan, will be a co-permittee with the Owner. The General Contractor shall be responsible for compliance with and fulfilling all requirements of the NPDES General Permit Number 2, including the Storm Water Pollution Prevention Plan.

.4 The initial Storm Water Pollution Prevention Plan and Notice of Intent will be provided by the Owner. These and the General Contractor's project inspection diary must be kept on-site and presented to federal, state and local environmental regulatory personnel, and the Owner, when requested.

.5 The General Contractor will provide an individual experienced with storm water pollution prevention plans and techniques to conduct weekly and rainfall inspections of the construction site and review the project's Storm Water Pollution Prevention Plan at the time of each inspection. The General Contractor is responsible for maintaining a copy of each inspection report. The General Contractor will review the weekly and rainfall storm water inspection reports and address any deficiencies within seven days. Deficiencies may also be identified by the Owner at any time. Corrective actions may include installation of additional erosion controls and/or maintenance of existing controls.

.6 If the Contractor should fail to conduct inspections, create reports, maintain the project inspection diary, and address deficiencies, the Owner, after giving the Contractor forty-eight hours notice, may do so and the Owner shall be entitled to reimbursement from the Contractor.

The General Contractor shall be responsible for continuing compliance with all SWPPP requirements until final stabilization is achieved regardless of whether Substantial Completion has been granted or the Owner has occupied any portion of the site or facility. Such practices shall include, but not be limited to, inspections and reports and maintenance of erosion control measures as described above.

.7 The Owner will file a Notice of Discontinuation upon final stabilization of the disturbed area. The General Contractor will provide the original project inspection diary and the marked-up copy of the Storm Water Pollution Prevention Plan to the Owner at the completion of the project.

#### **10.7.5 Removal of Regulated Wastes:**

.1 At the completion of the construction project, the Contractor will be required to remove all waste and unused hazardous chemicals including, but not limited to: solvents, adhesives, paints, and fuels. Said materials shall be properly identified, containerized and, if no longer usable, disposed at the Contractor's expense.

### **REFERENCE ARTICLE 11- INSURANCE AND BONDS**

#### **53. Reference Section 11.1; Add Sections:**

**11.1.5 Insurance:** No prime Contractor shall commence work under this contract until he/she has obtained all insurance required under this Section and until such insurance has been approved by the Owner, nor his/her sub-contractor until all similar insurance required of the subcontractor has been obtained and approved. No policy of insurance which is cancelable on less than 30 days written notice to the insured is satisfactory to the Owner's Representative.

**11.1.6 Compensation and Employer's Liability Insurance:** The Contractor shall take out and maintain during the life of this Contract the Statutory Workmen's Compensation and Employer's Liability Insurance for all of his/her employees to be engaged in work on the project under this Contract, and in case any work is sublet, the Contractor shall require the subcontractor similarly to provide Workmen's Compensation and Employer's Liability Insurance for all of the latter's employees to be engaged in such work.

**11.1.7 Bodily Injury Liability and Property Damage Liability Insurance:** Each prime Contractor shall take out and maintain during the life of the Contract such Bodily Injury Liability and Property

Damage Liability Insurance as shall protect him/her and any subcontractor performing work covered by the Contract from claims for damage for personal injury, including accidental death, as well as from claims for property damage, which may arise from operations under this Contract, whether such operations be by him/herself or by any subcontractor or by anyone directly or indirectly employed by either of them and the amount of such insurance shall be no less than:

.1 Public Liability Insurance, in an amount no less than Five Hundred Thousand Dollars (\$500,000.00), for injuries including wrongful death to any one person, and subject to the same limit for each person in any amount not less than One Million Dollars (\$1,000,000.00) on account of one accident.

.2 Property Damage Insurance, in a minimum amount of One Million Dollars (\$1,000,000.00) for damages on account of all accidents other than automobile property damage accidents.

.3 Motor Vehicle Bodily Injury Liability in a minimum amount of Five Hundred Thousand Dollars (\$500,000.00), per occupant and One Million Dollars (\$1,000,000.00) per accident on account of any one automobile accident.”

**11.1.8 Insurance Certificates:** Each prime Contractor shall furnish certificates of insurance listed above to the Owner and they shall also be subject to the Owner’s approval for adequacy of protection.”

**11.1.9 Owner’s Protective Liability Insurance:** Each prime Contractor shall take out and furnish to the Owner and maintain during the life of this Contract, complete Owner’s Protective Liability Insurance in amounts as specified in Section 11.1.7 above, for Bodily Injury Liability Insurance and for Property Damage Liability Insurance.”

**11.1.10** All insurance coverage must be provided by insurance companies having policy holder ratings no lower than “A” and financial ratings not lower than “XII” in the Best’s Insurance Guide, latest edition in effect as of the date of the Contract.

**11.1.11** The required limits of liability may be met by using a split-limit or a combined single limit basis. However, the total limit of liability cannot be less than that stated in the requirements.

54. Reference Section 11.3; The Contractor is directed to purchase and maintain Builder’s Risk insurance. Modify Section 11.3 and subsections as follows:

a. Modify the first sentence of Section 11.3.1 as follows: Delete “Unless otherwise provided, the Owner” and substitute “The Contractor”. Add the following sentence:

If the Owner is damaged by the failure of the Contractor to purchase and maintain such insurance without so notifying the Owner in writing, then the Contractor shall bear all reasonable costs attributable thereto.

b. Delete Section 11.3.1.2.

c. Modify Section 11.3.1.3 by substituting “Contractor” for “Owner”.

d. Modify Section 11.3.2 by substituting “Contractor” for “Owner” at the first reference to “Owner”.

e. Delete Section 11.3.4.

f. Modify Section 11.3.6 by making the following substitutions: (1) in the first sentence, substitute “Contractor” for “Owner” and “Owner” for “Contractor”, and (2) substitute “Owner” for “Contractor” at the end of the last sentence.

g. Modify Section 11.3.7 by substituting “Contractor” for “Owner” at the end of the first sentence.

- h. Modify Section 11.3.8 by substituting "Contractor" for "Owner"; each time the latter word appears except that at the first reference to "Owner" in the first sentence, the word "this" should be substituted for "the Owner's".
- i. Modify Section 11.3.9 by substituting "Contractor" for "Owner" each time the latter word appears except at the third occurrence in the third sentence and in the last sentence.
- j. Modify Section 11.3.10 by substituting "Contractor" for "Owner" each time the latter word appears except at the third occurrence in the first sentence and in the first occurrence in the last sentence.

55. Reference Section 11.4; Delete Section 11.4.1 and substitute the following:

**11.4.1** The Contractor shall furnish bonds on the date of execution of the Contract covering faithful performance of the Contract and payment of obligations arising thereunder as stipulated in the Bidding Requirements or specifically required in the Contract Documents. The bond shall be on the form prescribed in the Bidding Requirements and the cost thereof shall be included in the Contract Sum. The amount of each bond shall be equal to one hundred percent (100%) of the Contract Sum.

.1 The Contractor shall deliver the required bonds to the Owner simultaneously with the delivery of the executed Contract.

.2 The Contractor shall require the attorney-in-fact who executes the required bonds on behalf of the surety to affix thereto a certified and current copy of the power of attorney.

56. Reference Section 11.4; Add Section:

**11.4.3** If any surety upon any bond furnished in connection with this Contract becomes unacceptable to the State, or if any such surety fails to furnish reports as to their financial condition from time to time as additional security as may be required from time to time to protect the interests of the State or of persons supplying labor or materials in the prosecution of the Work contemplated by the Contract, the State may terminate the Contract.

## REFERENCE ARTICLE 12- UNCOVERING AND CORRECTION OF WORK

57. Reference Section 12.1.2; Add Section:

**12.1.2.1** If the condition noted in Section 12.1.2 above was caused by a separate contractor, the Contractor shall first attempt to reach settlement with the separate contractor as provided in Article 6.

58. Reference Section 12.2.2; Add the following sentence to Section 12.2.2.1:

The obligations of the Contractor under this Section shall survive termination of the Contract.

59. Reference Section 12.2.2; Add Sections:

**12.2.2.4** Upon request by the Owner and prior to the expiration of one year from the date of Substantial Completion, the Architect will conduct and the Contractor shall attend a meeting with the Owner to review the facility operations and performance.

**12.2.2.5** If it becomes necessary for the Contractor to replace an item after Substantial Completion under the terms of the Contract Documents, the warranty period of time for the replacement shall begin with the date of the completion of the replacement.

**12.2.2.6** If the Contractor does not proceed with correction of such nonconforming Work within a reasonable time fixed by written notice, the Owner may remove it and store the salvageable materials or equipment at the Contractor's expense. If the Contractor does not pay costs of such removal and storage within ten (10) days after written notice, the Owner may, upon ten (10) additional days written notice, sell such materials and equipment and account for the proceeds

thereof, after deducting costs and damages that should have been borne by the Contractor, including compensation of the Owner's services and expenses made necessary by this action. If such proceeds of sale do not cover costs which the Contractor should have borne, the Contract Sum will be reduced by the deficiency. If payments then or thereafter due the Contractor are not sufficient to cover such amount, the Contractor must pay the difference to the Owner.

## **REFERENCE ARTICLE 13 - MISCELLANEOUS PROVISIONS**

60. Reference Section 13.1; Delete the words following "...where the Project is located".

61. Reference Section 13.5.1; Add Section:

**13.5.1.1** Special Inspections, if required for this Project by the Contract Documents, will be procured and paid for by the Owner. The duties and responsibilities of the Contractor in regard to Special Inspections shall be as defined in the General Requirements of the Contract Documents. Special Inspections, if required, are separate and distinct from other Tests and Inspections required by the Contract Documents which shall be procured and paid for by the Contractor under the provisions of Section 13.5.

62. Reference Section 13.6; Delete Section 13.6 and substitute the following:

**13.6 INTEREST:** Payments due and unpaid under the Contract Documents shall bear interest in accordance with Section 573.12 and 573.14 of the Code of Iowa.

63. Reference Section 13.7; Delete Section in its entirety and substitute the following:

### **13.7 COMMENCEMENT OF STATUTORY LIMITATION PERIOD**

**13.7.1** As between the Owner and Contractor:

.1 Before Substantial Completion. As to acts or failures to act occurring prior to the relevant date of Substantial Completion, any applicable statute of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than such date of Substantial Completion;

.2 Between Substantial Completion and Final Certificate for Payment. As to acts or failures to act occurring subsequent to the relevant date of Substantial Completion and prior to issuance of the final Certificate for Payment, any applicable statute of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than the date of issuance of the final Certificate for Payment; and

.3 After Final Certificate for Payment. As to acts or failures to act occurring after the relevant date of issuance of the final Certificate for Payment, any applicable statute of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than the date of any act or failure to act by the Contractor pursuant to any Warranty provided under Section 3.5, the date of any correction of the Work or failure to correct the Work by the Contractor under Section 12.2, or the date of actual commission of any other act or failure to perform any duty or obligation by the Contractor or Owner, whichever occurs last.

64. Reference Article 13; Add Sections:

### **13.8 ENERGY REBATE FORM(S)**

**13.8.1** The Contractor shall obtain Energy Rebate Forms from all applicable utility providers for the Work. The Contractor shall partially complete and sign the rebate forms; providing the information identified below. The Contractor shall submit the rebate forms with the Application for Final Payment as directed in Article 9.

Lighting:

1. List brand name & model number of fixture(s).

2. List number of fixtures installed.
3. Provide a copy of invoice(s) from supplier to Contractor.
4. Provide Contractor signature.
5. Note: Owner will provide remaining information such as account number, age and size of facility, hours of operation, etc.

HVAC:

1. List manufacturer, size, efficiency, model number, serial number, and installed cost of unit(s). Include manufacturer, model, and installed cost of programmable thermostats.
2. Provide a copy of invoice(s) from the Supplier to Contractor.
3. Provide Contractor signature.
4. Note: Owner will provide remaining information such as account number, age and size of facility, hours of operation, etc.

Motors:

1. List variable speed drive information including manufacturer, model number, serial number, rating, efficiency, equipment cost, and installation cost.
2. List NEMA Premium motor information including manufacturer, model number, serial number, HP rating, efficiency, motor speed, and motor and installation cost.
3. Provide a copy of invoice(s) from the Supplier to Contractor.
4. Provide Contractor signature.
5. Note: Owner will provide remaining information such as account number, age and size of facility, hours of operation, etc.

**13.9 MANUFACTURER'S DIRECTIONS**

**13.9.1** Manufactured articles, materials, and equipment shall be applied, installed, connected, erected, used, cleaned, and conditioned as directed by the manufacturer unless herein specified to the contrary.

**13.9.2** Any additional costs incurred as a result of this requirement shall be borne by the Contractor.

**13.10 CODE OF FAIR PRACTICES**

**13.10.1** During the performance of this Contract, the Contractor agrees as follows:

.1 The Contractor will not discriminate against any employee or applicant for employment because of race, creed, color, religion, national origin, sex, age, or physical or mental disability, or status as a Vietnam-era disabled veteran. The Contractor will take affirmative action to ensure that applicants are employed and that employees are treated during employment without regard to their race, creed, color, religion, national origin, sex, age, physical or mental disability, or status as a Vietnam-era disabled veteran except where it relates to a bona fide occupational qualification. Such action includes but is not limited to the following: employment, upgrading, demotion or transfer, recruitment or recruitment advertising, layoff or terminations, rates of pay or other forms of compensation, and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices provided by the Owner setting forth provisions of the nondiscrimination clause.

.2 The Contractor will in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, creed, color, religion, national origin, sex, age, physical or mental disability, or status as a Vietnam-era disabled veteran except where it relates to a bona fide occupational qualification.

.3 The Contractor will send to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding a notice advising the labor union or workers' representative of the Contractor's commitments under this

nondiscrimination clause and post copies of the notice in conspicuous places available to employees and applicants for employment.

.4 The Contractor will comply with all relevant provisions of the Iowa Civil Rights Act of 1965, as amended by Iowa Executive order #15 of 1973, as amended by Iowa Executive Order #34 of 1988; Federal Executive Order 11246 of 1965, as amended by Federal Executive Order 11375 of 1967; the Equal Employment Opportunity Act of 1972; and all provisions relevant to fair application of the rules and regulations of the Owner. The Contractor will furnish all information and reports requested by the Owner or required by or pursuant to the rules and regulations thereof and will also permit access to its payroll and employment records by the Owner or representatives for purposes of investigation to ascertain compliance with such rules, regulations, or requests, or with this nondiscrimination clause.

.5 In the event of the Contractor's noncompliance with the nondiscrimination clauses of this Contract or with any of the aforesaid rules, regulations, or requests, this Contract may be canceled, terminated, or suspended in whole or in part and the Contractor may be declared ineligible for further contracts with the Owner. In addition, the Owner may take such further action, and such other sanctions may be imposed and remedies invoked, as provided by the Iowa Civil Rights Act of 1965 as amended, Chapter 601A, Code of Iowa, as heretofore and hereafter amended, or by the rules and regulations of the Owner or as otherwise provided by law.

.6 The Contractor will include the provisions of this section of Article 13 hereof in every subcontract and purchase order unless specifically exempt by approval of the Owner, in accordance with the rules and regulations, so that such provisions will be binding on each Subcontractor and vendor. The Contractor will take such action with respect to any Subcontractor or purchase order as the Owner or the authorized representative thereof may direct as a means of enforcing such provisions including sanctions for noncompliance; provided however, that in the event the Contractor becomes involved in, or is threatened with, litigation by a Subcontractor or vendor as a result of such direction by the Owner, the Contractor may request the State of Iowa to enter into such litigation to protect the interests of the State of Iowa.

## **REFERENCE ARTICLE 14 - TERMINATION OR SUSPENSION OF THE CONTRACT**

65. Reference Section 14.3; Add Section:

**14.3.3** Adjustments made for increases in the cost may have a mutually agreed fixed or percentage fee.

66. Reference Section 14.4; Delete Section 14.4.3 and substitute the following:

**14.4.3** In case of such termination for the Owner's convenience, the Contractor shall be entitled to receive from the Owner, payment for Work executed and for proven loss with respect to material, equipment, tools, and construction equipment and machinery, including reasonable overhead and profit. The Contractor shall transfer title to Owner and deliver in the time, place and manner as directed by the Owner, all fabricated and unfabricated parts, Work-in-process, completed Work, supplies and other materials produced as part of, or acquired in connection with the discontinued Work, and other property which would have been required to be furnished to Owner if the Contract had been completed.

67. Reference Article 14; Add Section:

### **14.5 MISCELLANEOUS TERMINATION**

**14.5.1** Funding: If the Bidding Requirements indicate Federal funding for this project is received from the Federal Government prior to award of the Contract and such Federal funding is not received within the sixty (60) day bid guarantee after the date of receiving bids, all rights and obligations to enter into a Contract are considered null and void.

**14.5.2** Provisions of law as contained in Chapter 573A of the Code of Iowa, current edition (which pertains to termination of contracts for construction of public improvements when Work thereon is stopped because of a national emergency), applies to and is a part of this Contract and binding upon all parties hereto, including Subcontractors and sureties.

## **REFERENCE ARTICLE 15 – CLAIMS AND DISPUTES**

68. Reference Section 15.1.5.1; Add Section:

**15.1.5.1.a** The Contractor shall not be entitled to an increase in the Contract Sum as a result of any delays in the progress of the Work. The Contractor's sole remedy for delay is an extension of time, extended by Change Order for such reasonable time as proposed by the Contractor and approved by the Owner.

END OF DOCUMENT 00 73 00

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SECTION 01 10 00

PLANS LIST

**S-29 MILLER ARMORY LATRINE ADDITION**

Contract # C32998060

1. PLANS

The work shall conform with the following drawings (bound separately) and applicable figures in the Statewide Urban Standard Specifications for Public Improvements (SUDAS)

| <u>SHEET DESCRIPTION</u>                 | <u>SHEET NUMBERS</u> |
|------------------------------------------|----------------------|
| COVER SHEET                              | G000                 |
| PROJECT GENERAL INFORMATION              | G001                 |
| LIFE SAFETY PLAN                         | G100                 |
| GENERAL CIVIL NOTES                      | C001                 |
| EXISTING CONDITIONS AND DEMOLITION PLAN  | CD01                 |
| SITE PLAN                                | C101                 |
| GRADING PLAN                             | C201                 |
| UTILITY PLAN                             | C301                 |
| CONSTRUCTION DETAILS                     | C501                 |
| STRUCTURAL GENERAL INFORMATION           | S000                 |
| SPECIAL INSPECTIONS                      | S001                 |
| FOUNDATION AND ROOF FRAMING PLANS        | S100                 |
| FOUNDATION DETAILS                       | S500                 |
| FOUNDATION DETAILS                       | S501                 |
| FRAMING DETAILS                          | S510                 |
| DEMOLITION PLANS                         | AD01                 |
| ARCHITECTURAL GENERAL INFORMATION        | A001                 |
| FLOOR PLANS AND ENLARGED PLAN            | A101                 |
| REFLECTED CEILING PLAN AND ROOF PLAN     | A111                 |
| FINISH PLAN                              | A131                 |
| EQUIPMENT PLAN                           | A141                 |
| EXTERIOR ELEVATIONS AND BUILDING SECTION | A200                 |
| INTERIOR ELEVATIONS AND CASEWORK DETAILS | A210                 |
| INTERIOR ELEVATIONS AND CASEWORK DETAILS | A211                 |
| WALL SECTIONS                            | A310                 |
| INTERIOR PARTITION INFORMATION           | A320                 |
| DETAILS                                  | A500                 |
| DOOR INFORMATION AND DETAILS             | A600                 |
| STOREFRONT ELEVATIONS AND DETAILS        | A601                 |

|                                             |      |
|---------------------------------------------|------|
| PLUMBING GENERAL INFORMATION                | P000 |
| PLUMBING DEMOLITION PLAN                    | PD01 |
| STORM, SANITARY AND VENT UNDERFLOOR PLAN    | P100 |
| STORM, SANITARY AND VENT FLOOR PLAN         | P101 |
| STORM, SANITARY AND VENT ROOF PLAN          | P102 |
| DOMESTIC WATER FLOOR PLAN                   | P201 |
| OVERALL BUILDING PLAN                       | P400 |
| PLUMBING DETAILS                            | P501 |
| PLUMBING DETAILS AND SCHEDULES              | P600 |
| MECHANICAL GENERAL INFORMATION              | M000 |
| MECHANICAL DEMOLITION PLAN                  | MD01 |
| MECHANICAL FLOOR PLAN                       | M101 |
| MECHANICAL ROOF PLAN                        | M102 |
| RTU-12 MECHANICAL CONTROL SCHEMATICS        | M500 |
| MECHANICAL CONTROLS                         | M501 |
| MECHANICAL DETAILS AND SCHEDULES            | M600 |
| ELECTRICAL GENERAL INFORMATION              | E000 |
| FIRST FLOOR ELECTRICAL DEMO & LIGHTING PLAN | E101 |
| FIRST FLOOR POWER & SYSTEMS PLAN            | E102 |
| ELECTRICAL SCHEDULES AND DETAILS            | E600 |

SECTION 02 41 00  
DEMOLITION

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Selective demolition of built site elements.
- B. Selective demolition of building elements for alteration purposes.
- C. Abandonment and removal of existing utilities and utility structures.

1.2 REFERENCE STANDARDS

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

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Site Plan: Showing:
  - 1. Vegetation to be protected.
  - 2. Areas for temporary construction and field offices.
- C. Demolition Plan: Submit demolition plan as specified by OSHA and local authorities.
  - 1. NESHAPS Notification: Submit a copy of the National Emissions Standard for Hazard Air Pollutants (NESHAP) Notification Form. Contractor shall be responsible for submitting this notification form to the appropriate regulatory agencies.
- D. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.
- E. The Contractor shall submit demolition procedures and operational sequence for review and acceptance by the Architect/Engineer if a portion of the existing facility is to remain in operation during construction and phasing is not specified in the plans or specifications.
- F. Schedule indicating proposed sequence of operations for selective demolition work to Architect/Engineer for review prior to start of work. Include coordination for shutoff, capping, and continuation of utility services as required, together with details for dust and noise control protection.

**PART 2 PRODUCTS**

2.1 MATERIALS

- A. Fill Material: As specified in Section 31 23 23 - Fill.

**PART 3 EXECUTION**

3.1 SCOPE

- A. Remove portions of the existing building as indicated on the drawings.

- B. Remove other items for indicated for salvage and relocation.
- C. Remove paving and curbs as required to accomplish new work.
- D. Fill excavations, open pits, and holes in ground areas generated as result of removals, using specified fill; compact fill as required so that required rough grade elevations do not subside within one year after completion.

### 3.2 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
  - 1. Obtain required permits.
  - 2. Comply with applicable requirements of NFPA 241.
  - 3. Use of explosives is not permitted.
  - 4. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
  - 5. Provide, erect, and maintain temporary barriers and security devices.
  - 6. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
  - 7. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
  - 8. Do not close or obstruct roadways or sidewalks without permit.
  - 9. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
- B. Do not begin removal until receipt of notification to proceed from Owner.
- C. Protect existing structures and other elements that are not to be removed.
  - 1. Provide bracing and shoring.
  - 2. Prevent movement or settlement of adjacent structures.
  - 3. Stop work immediately if adjacent structures appear to be in danger.
- D. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
- E. If hazardous materials are discovered during removal operations, stop work and notify Architect/Engineer and Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.
- F. Perform demolition in a manner that maximizes salvage and recycling of materials.
  - 1. Dismantle existing construction and separate materials.
  - 2. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.
- G. Accurately record locations of capped utilities and subsurface obstructions on the Contractor's record drawing set.

- H. In removing pavement, curb, curb and gutter, gutters, sidewalks, and other similar improvements, and where a portion of such improvements are to be left in place, they shall be removed to an existing joint or to a joint sawed to a minimum depth of 1 inch (25 mm) with a true line and a vertical face. Sufficient removal shall be made to provide for proper grade and connections in the new work regardless of any limits which may be indicated on the Plans.
- I. Existing castings and culverts, if salvageable and removed intact, shall remain the property of the Owner. The Contractor shall use reasonable care in their removal and shall leave on the Owner's property if owned privately or arrange pickup by the appropriate agency if owned publicly.
- J. All sewers, drainage pipe, and floor drains which have been or are to be abandoned shall be permanently sealed at the ends with bulkheads constructed of concrete, having a minimum thickness of 8 inch (200 mm). No direct payment will be made for blocking abandoned sewers, drainage pipes, or floor drains.
- K. Abandon storm or sanitary sewer structures by breaking the concrete bottom of the structure into pieces no larger than 1 foot (300 mm) in any direction and removing the top of the structure to 3 feet (900 mm) below finished grade. Plug all pipes with concrete and fill structure with compacted sand or 3/4 inch (19 mm) clean gravel.

### 3.3 EXISTING UTILITIES

- A. Contractor must always use Iowa OneCall. for utility locates. Submit request for "Joint Meet" so exact locations needed get marked. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.
- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.
- H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone; identify and mark utilities to be subsequently reconnected, in same manner as other utilities to remain.
- I. Contractor is responsible for the adjustment of all gas vents, manholes, castings, and water valves to match the new surface. Adjustments shall be coordinated with the utility companies and the cost for all adjustments shall be incidental to construction. Any damage to said structures and appurtenances, that occurs during construction, shall be repaired by the Contractor at no additional cost to the Owner.

### 3.4 SELECTIVE DEMOLITION FOR ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
  - 1. Report discrepancies to Architect/Engineer before disturbing existing installation.

2. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- B. Remove existing work as indicated and as required to accomplish new work.
1. Remove items indicated on drawings.
- C. Protect existing work to remain.
1. Prevent movement of structure; provide shoring and bracing if necessary.
  2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
  3. Repair adjacent construction and finishes damaged during removal work.
  4. Patch as specified for patching new work.

### 3.5 DEBRIS AND WASTE REMOVAL

- A. Remove debris, junk, and trash from site.
- B. Leave site in clean condition, ready for subsequent work.
- C. Clean up spillage and wind-blown debris from public and private lands.

**END OF SECTION**

SECTION 03 30 00  
CAST-IN-PLACE CONCRETE

**PART 1 GENERAL**

1.1 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
  - 1. Footings and foundations.
  - 2. Foundation walls.
  - 3. Slabs-on-grade.
  - 4. Diamond Dowels at construction joints
  - 5. Synthetic Macrofiber Reinforcement

1.2 REFERENCE STANDARDS

- A. AASHTO M 182 - Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats; 2005.
- B. ACI 117 - Specifications for Tolerances for Concrete Construction and Materials; 2010 (Reapproved 2015).
- C. ACI 301 - Specifications for Structural Concrete; 2016.
- D. ACI 302.1R - Guide to Concrete Floor and Slab Construction; 2015.
- E. ACI 305R - Guide to Hot Weather Concreting; 2010.
- F. ACI 306R - Guide to Cold Weather Concreting; 2016.
- G. ACI 308R - Guide to External Curing of Concrete; 2016.
- H. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2014 (Errata 2018).
- I. ACI 347R - Guide to Formwork for Concrete; 2014, with Errata (2017).
- J. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2018a.
- K. ASTM A184/A184M - Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement; 2019.
- L. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2018.
- M. ASTM A706/A706M - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement; 2016.
- N. ASTM A775/A775M - Standard Specification for Epoxy-Coated Steel Reinforcing Bars; 2017.
- O. ASTM A934/A934M - Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars; 2016.
- P. ASTM C1017/C1017M - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete; 2013.
- Q. ASTM C1059/C1059M - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete; 2013.

- R. ASTM C1064/C1064M - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete; 2012.
- S. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens); 2016a.
- T. ASTM C1116/C1116M - Standard Specification for Fiber-Reinforced Concrete; 2010a (Reapproved 2015).
- U. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete; 2011.
- V. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2015a.
- W. ASTM C150/C150M - Standard Specification for Portland Cement; 2019a.
- X. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete; 2016.
- Y. ASTM C172/C172M - Standard Practice for Sampling Freshly Mixed Concrete; 2010.
- Z. ASTM C219 - Standard Terminology Relating to Hydraulic Cement; 2014.
- AA. ASTM C231/C231M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method; 2014.
- BB. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a (Reapproved 2016).
- CC. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2011.
- DD. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field; 2012.
- EE. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2018.
- FF. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2018.
- GG. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2017.
- HH. ASTM C595/C595M - Standard Specification for Blended Hydraulic Cements; 2021.
- II. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2019.
- JJ. ASTM C881/C881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete; 2015.
- KK. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2018.
- LL. ASTM D785 - Standard Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials; 2008 (Reapproved 2015).
- MM. ASTM D1709 - Standard Test Methods for Impact Resistance of Plastic Film by the Free-Falling Dart Method; 2016a, with Editorial Revision (2017).
- NN. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015 (Reapproved 2021).
- OO. ASTM D3963/D3963M - Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars; 2015.
- PP. ASTM D882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting; 2018.
- QQ. ASTM E1155 - Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers; 2014.



- RR. ASTM E1643 - Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs; 2011 (Reapproved 2017).
- SS. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2017.
- TT. ASTM F1249 - Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor; 2020.
- UU. AWS D1.4/D1.4M - Structural Welding Code - Reinforcing Steel; 2011.

### 1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
  - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For installer and manufacturer.
- B. Welding certificates.
- C. Material Certificates: For each of the following, signed by manufacturers:
  - 1. Cementitious materials.
  - 2. Admixtures.
  - 3. Form materials and form-release agents.
  - 4. Steel reinforcement and accessories.
  - 5. Fiber reinforcement.
  - 6. Floor and slab treatments.
  - 7. Bonding agents.
  - 8. Adhesives.
  - 9. Vapor barriers.
  - 10. Semirigid joint filler.
  - 11. Joint-filler strips.
  - 12. Repair materials.
- D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

1. Aggregates. Include test results per ASTM C295 indicating aggregate is free of materials with deleterious reactivity to alkali in cement.
- E. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.
- F. Field quality-control reports.

## 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
  1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C1077 and ASTM E329 for testing indicated.
  1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
  2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D1.4M, "Structural Welding Code - Reinforcing Steel."
- F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
  1. ACI 301, "Specifications for Structural Concrete, Sections 1 through 5.
  2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.

## PART 2 PRODUCTS

### 2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
  1. Plywood, metal, or other approved panel materials.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

- C. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.
- D. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.
- E. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- F. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
  - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- G. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
  - 1. Furnish units that will leave no corrodible metal closer than 1 inch (25 mm) to the plane of exposed concrete surface.
  - 2. Furnish ties that, when removed, will leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.
  - 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

## 2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A615/A615M, Grade 60 (Grade 420), deformed.
- B. Epoxy-Coated Reinforcing Bars: ASTM A615/A615M Grade 60, deformed bars, ASTM A775/A775M or ASTM A934/A934M, epoxy coated, with less than 2 percent damaged coating in each 12 inch (300 mm) bar length.
- C. Plain-Steel Welded Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.

## 2.3 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A615/A615M, Grade 60 (Grade 420), plain-steel bars, cut true to length with ends square and free of burrs.
- B. Epoxy-Coated Joint Dowel Bars: ASTM A615/A615M, Grade 60 (Grade 420), plain-steel bars, ASTM A775/A775M epoxy coated.
- C. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A775/A775M.
- D. Diamond Plate Dowels: Provide one of the following:
  - 1. Diamond Dowel System by PNA Construction Technologies
  - 2. Pre-approved equivalent
- E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
  - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
  - 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
  - 3. Supporting reinforcement on clay brick supports is not acceptable.

## 2.4 CONCRETE MATERIALS

- A. Cementitious Material: Use one of the following cementitious materials, of the same type, brand, and source, throughout Project:
  - 1. Portland Cement: ASTM C150/C150M, Type I/II, gray Supplement with the following at contractor's option:
    - a. Fly Ash: ASTM C618, Class F or Class C.
  - 2. Blended Hydraulic Cement: ASTM C595/C595M, Type IL, portland-limestone cement.
    - a. Fly Ash: ASTM C618, Class F or Class C.
- B. Normal-Weight Aggregates: ASTM C33/C33M, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
  - 1. Maximum Coarse-Aggregate Size: 1 inch (25 mm) nominal.
  - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement. For slabs-on-grade or concrete exposed to view, use fine aggregate with a proven history of not being susceptible to popouts, use imported sand if necessary.
- C. Water: ASTM C94/C94M and potable.

## 2.5 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C260/C260M.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
  - 1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
  - 2. Retarding Admixture: ASTM C494/C494M, Type B.
  - 3. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.
  - 4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
  - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G.
  - 6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.

## 2.6 FIBER REINFORCEMENT

- A. Synthetic Macro-Fiber: Polyolefin macro-fibers engineered and designed for use in concrete, complying with ASTM C1116/C1116M Type III, 1 to 2 1/4 inch (25 to 57 mm) long.
  - 1. Manufacturers: Subject to compliance with requirements, provide one of the following:
    - a. Euclid Chemical Company (The); Tuf-Strand SF.
    - b. FORTA Corporation; FORTA FERRO.
    - c. GCP Applied Technologies; Strux 90/40.
    - d. Master Builders Solutions; MasterFiber MAC 100
    - e. Nycon, Inc.; XL.
    - f. Sika Corporation; Sika Fibermesh 650.

## 2.7 VAPOR BARRIERS

- A. Sheet Vapor Barrier, ASTM E1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.
  - 1. Minimum thickness; 15 mil.
  - 2. Water Vapor Permeance, ASTM F1249 Section 7; less than 0.01 Perms.
  - 3. Tensile Strength, ASTM D882 Section 9; 45 lb/in minimum.
  - 4. Puncture Resistance, ASTM D1709, Test Method B; 2200 grams minimum.
  - 5. Manufacturers: Subject to compliance with requirements, provide one of the following:
    - a. Fortifiber Building Systems Group; Moistop Ultra 15.
    - b. ISI Building Products.; Viper II 15 mil.
    - c. Inteplast Group; Barrier-Bac V-350 (15 mil).
    - d. Meadows, W. R., Inc.; Perminator 15 mil.
    - e. Stego Industries, LLC; Stego Wrap 15 mil Class A.
    - f. Yellow Guard; Husky Yellow Guard 15 mil Vapor Barrier
- B. Granular Fill: For drainage course below vapor barrier, see Section 31 2000 Earth Moving (SUDAS Section 2010).

## 2.8 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.
  - 1. Manufacturers: Subject to compliance with requirements, provide one of the following:
    - a. ChemMasters; Chemisil Plus.
    - b. ChemTec Int'l; ChemTec One.
    - c. Curecrete Distribution Inc.; Ashford Formula.
    - d. Dayton Superior Corporation; Sure Hard Densifier J-17.
    - e. Euclid Chemical Company (The); Euco Diamond Hard.
    - f. Kaufman Products, Inc.; SureHard.
    - g. Latricrete International, Inc.; L&M Seal Hard.
    - h. Meadows, W. R., Inc.; LIQUI-HARD.
    - i. Metalcrete Industries; Floorsaver.
    - j. Nox-Crete Products Group; Duro-Nox.
    - k. Vexcon Chemicals, Inc.; Vexcon StarSeal PS Clear.
  - 2. Provide liquid floor treatment at all locations in which sealed concrete is the specified floor finish.

## 2.9 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.
- C. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
  - 1. Manufacturers: Subject to compliance with requirements, provide the following:
    - a. Anti-Hydro International, Inc.; AH Clear Cure WB.
    - b. BASF Construction Chemicals - Master Builders Solutions; MasterKure CC 160 WB.
    - c. ChemMasters; Safe-Cure & Seal 309.
    - d. Cresset Chemical Company; Crete-Trete 309-VOC Cure & Seal.
    - e. Dayton Superior Corporation; Cure & Seal 309 J18.
    - f. Euclid Chemical Company (The); Aqua Cure VOX.
    - g. Kaufman Products, Inc.; Krystal 15 Emulsion.
    - h. Laticrete International, Inc.; L&M Dress & Seal WB.
    - i. Meadows, W. R., Inc.; Vocomp-20.
    - j. Metalcrete Industries; Metcure.
    - k. Nox-Crete Products Group; Cure & Seal 150E.
    - l. Vexcon Chemicals, Inc.; Starseal 309.

## 2.10 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: Flexible, closed-cell polyethylene with tear off strip for sealant installation.
  - 1. Manufacturers: Subject to compliance with requirements, provide one of the following:
    - a. NMW, Inc; Foamtech.
    - b. Nmaco; Fastflex
    - c. W.R. Meadows; Deck-O-Foam.
- B. Bonding Agent: ASTM C1059/C1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- C. Epoxy Bonding Adhesive: ASTM C881/C881M, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
  - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

## 2.11 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.
  - 1. Cement Binder: ASTM C150/C150M, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C219.
  - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
  - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by underlayment manufacturer.
  - 4. Compressive Strength: Not less than 4100 psi (29 MPa) at 28 days when tested according to ASTM C109/C109M.

## 2.12 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
  - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
  - 1. Fly Ash: 25 percent.
  - 2. CarbonCure: CarbonCure injected carbon dioxide system is permitted at contractor's option to reduce Portland cement content by up to 3%. CarbonCure shall be added to the mix using the CarbonCure delivery system. The delivery shall be provided and calibrated by CarbonCure and integrated into the PCC plant batching system. The reduction is for Portland cement only and is determined after substitution of fly ash has occurred. Blended cements are to be considered cement when determining Portland cement reductions.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
  - 1. Use water-reducing or high-range water-reducing admixture in concrete, as required, for placement and workability.
  - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
  - 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.

## 2.13 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Footings and Foundation Walls: Proportion normal-weight concrete mixture as follows:
  - 1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
  - 2. Maximum Water-Cementitious Materials Ratio: 0.45.

3. Slump Limit: Concrete mix shall be proportioned to achieve a maximum slump of 9" for concrete containing high range water reducing admixture, 6" for concrete containing a mid-range water reducing admixture, or 4" for other concrete. All mixes shall have a water slump of 2" to 3".
  4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1 inch (25 mm) nominal maximum aggregate size.
- B. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
  2. Maximum Water-Cementitious Materials Ratio: 0.45.
  3. Slump Limit: Concrete mix shall be proportioned to achieve a maximum slump of 9" for concrete containing high range water reducing admixture, 6" for concrete containing a mid-range water reducing admixture, or 4" for other concrete. All mixes shall have a water slump of 2" to 3".
  4. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

#### 2.14 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

#### 2.15 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C94/C94M and ASTM C1116/C1116M, and furnish batch ticket information.
1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

### PART 3 EXECUTION

#### 3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
1. Class A, 1/8 inch (3.2 mm) for smooth-formed finished surfaces.
  2. Class B, 1/4 inch (6 mm) for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
1. Install keyways, reglets, recesses, and the like, for easy removal.
  2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.



- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

### 3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

### 3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.
  - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
  - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

### 3.4 VAPOR BARRIERS

- A. Sheet Vapor Barriers: Place, protect, and repair sheet vapor barrier according to ASTM E1643 and manufacturer's written instructions.
  - 1. Lap joints 6 inch (150 mm) and seal with manufacturer's recommended tape.

### 3.5 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor barrier. Repair damage and reseal vapor barrier before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
  1. Weld reinforcing bars according to AWS D1.4/D1.4M, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.
- F. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D3963/D3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.

### 3.6 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
  1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
  2. Space vertical joints in walls at distance needed for construction sequencing. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
  1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8 inch (3.2 mm) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
  1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
  2. Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface where joint sealants, specified in Division 07 section "Joint Sealants," are indicated.
  3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install diamond plate dowels and support assemblies at joints where indicated in compliance with manufacturer's written instructions. Size and spacing of diamond plates shall be in compliance with ACI 302.1R.

### 3.7 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
- C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
  - 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
  - 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
  - 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inch (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
  - 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  - 2. Maintain reinforcement in position on chairs during concrete placement.
  - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
  - 4. Slope surfaces uniformly to drains where required.
  - 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- E. Cold-Weather Placement: Comply with ACI 306R and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
  - 1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
  - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
  - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- F. Hot-Weather Placement: Comply with ACI 301 and ACI 305R and as follows:
  - 1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
  - 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

### 3.8 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
  - 1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
  - 1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.
- C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
  - 1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

### 3.9 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Straighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
  - 1. Apply float finish to surfaces to receive trowel finish or to be covered with fluid-applied or sheet waterproofing, built up or membrane roofing.
- C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and straighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
  - 1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
  - 2. Finish surfaces to the following tolerances, according to ASTM E1155, for a randomly trafficked floor surface:
    - a. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.
  - 3. Remedies for out-of-tolerance work:
    - a. Minimum local values measuring at or above all specified minimum local values F-numbers shall be accepted for tolerance compliance as constructed.

- b. Where minimum local values are measured to be below the specified F-numbers one of the following actions shall be performed. In all cases, the particular method of correction shall be determined solely by the Owner.
  - 1) The area within the boundaries of the minimum local area shall be removed and replaced and the area retested per ASTM E1155 to show tolerance compliance.
  - 2) The area within the boundary shall be repaired by grinding or depression-and-retopping of the entire minimum local area and the area retested per ASTM E1155 to show tolerance compliance.
- D. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
  - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect/Engineer before application.

### 3.10 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations:
  - 1. Coordinate sizes and locations of concrete bases with actual equipment provided.
  - 2. Construct concrete bases 4 inch (100 mm) high unless otherwise indicated; and extend base not less than 6 inch (150 mm) in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated.
  - 3. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
  - 4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18 inch (450 mm) centers around the full perimeter of concrete base.
  - 5. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

### 3.11 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306R for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

- E. Cure concrete according to ACI 308R, by one or a combination of the following methods:
1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
    - a. Water.
    - b. Continuous water-fog spray.
    - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12 inch (300 mm) lap over adjacent absorptive covers.
  2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inch (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
  3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
    - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
  4. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
  5. Cure concrete surfaces to receive floor coverings with either a moisture cure, a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

### 3.12 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.
1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
  2. Do not apply to concrete that is less than 28 days' old.
  3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

### 3.13 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
1. Defer joint filling until concrete has aged at least one month(s). Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

### 3.14 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect/Engineer. Remove and replace concrete that cannot be repaired and patched to Architect/Engineer's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
  - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension to solid concrete. Limit cut depth to 3/4 inch (19 mm). Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
  - 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
  - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect/Engineer.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
  - 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
  - 2. After concrete has cured at least 14 days, correct high areas by grinding.
  - 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
  - 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
  - 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

6. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4 inch (19 mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
  7. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect/Engineer's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect/Engineer's approval.

### 3.15 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections:
1. Steel reinforcement placement.
  2. Steel reinforcement welding.
  3. Headed bolts and studs.
  4. Verification of use of required design mixture.
  5. Concrete placement, including conveying and depositing.
  6. Curing procedures and maintenance of curing temperature.
  7. Verification of concrete strength before removal of shores and forms from beams and slabs.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C172/C172M shall be performed according to the following requirements:
1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. (76 cu. m) or fraction thereof of each concrete mixture placed each day.
    - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
  2. Slump: ASTM C143/C143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
  3. Air Content: ASTM C231/C231M, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
  4. Concrete Temperature: ASTM C1064/C1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
  5. Compression Test Specimens: ASTM C31/C31M.



- a. Cast and laboratory cure two sets of two standard 6 inch by 12 inch cylinder specimens for each composite sample or two sets of three standard 4 inch by 8 inch cylinder specimens for each composite sample.
  6. Compressive-Strength Tests: ASTM C39/C39M; test one set of laboratory-cured specimens at 7 days and one set of specimens at 28 days.
    - a. A compressive-strength test shall be the average compressive strength from a set of two specimens for 6 in by 12 inch cylinders or three specimens for 4 inch by 8 inch cylinders obtained from same composite sample and tested at age indicated.
  7. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).
  8. Test results shall be reported in writing to Owner, Architect/Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
  9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect/Engineer but will not be used as sole basis for approval or rejection of concrete.
  10. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect/Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42 (C42M) or by other methods as directed by Architect/Engineer.
  11. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- D. Measure floor and slab flatness and levelness according to ASTM E1155 within 72 hours of finishing.

### 3.16 PROTECTION OF LIQUID FLOOR TREATMENTS

- A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

**END OF SECTION**

SECTION 04 20 00  
UNIT MASONRY

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Concrete Masonry Units.
- B. Clay facing brick.
- C. Mortar and grout.
- D. Reinforcement and anchorage.
- E. Flashings.
- F. Lintels.
- G. Accessories.

1.2 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete
- B. Section 07 92 00 - Joint Sealants: Sealing control and expansion joints.

1.3 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- B. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2018.
- C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- D. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement; 2022.
- E. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2022.
- F. ASTM C91/C91M - Standard Specification for Masonry Cement; 2023.
- G. ASTM C140/C140M - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units; 2022c.
- H. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2018.
- I. ASTM C150/C150M - Standard Specification for Portland Cement; 2019a.
- J. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made From Clay or Shale); 2019.
- K. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019.
- L. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2018.
- M. ASTM C476 - Standard Specification for Grout for Masonry; 2022.
- N. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2017.
- O. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2016.

- P. ASTM C1019 - Standard Test Method for Sampling and Testing Grout for Masonry; 2020.
- Q. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms; 2022a.
- R. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
- S. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing; 2017.
- T. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2022.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all relevant installers, including the following:
  - 1. Contractor's superintendent
  - 2. Masonry subcontractor
  - 3. Independent testing agency

#### 1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, masonry accessories, anchors, and flashings.
- C. Shop Drawings: For reinforcing steel, detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement"
  - 1. Provide shop drawings with plans and elevations as appropriate for indicating control joint layout, reinforcement locations with size, grade, shapes of bent bars and location of splices. Include quantities, bar schedules supporting and spacing devices and accessories where required.
- D. Samples: Submit four samples for each facing brick unit type to illustrate color, texture, and extremes of color range.
- E. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.
  - 1. Masonry Units: For masonry units used in structural masonry, include data and calculations establishing that masonry units meet or exceed average net-area compressive strength.
  - 2. Cementitious materials. Include brand, type, and name of manufacturer.
  - 3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
  - 4. Grout mixes. Included description and type and proportions of ingredients.
- F. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.
- G. Cold-Weather and/or Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather and/or hot-weather requirements.
- H. Statement of Compatibility: For each flashing and sealant product in contact with fluid-applied vapor barrier system, provide Manufacturer's statement for compatibility.

## 1.6 QUALITY ASSURANCE

- A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
- B. Comply with the requirements of the Brick Institute of America Technical Notes. This specification and the drawings are intended to reflect the general provisions of the BIA technical notes. Any discrepancies between these specifications, the details and/or any provisions of the BIA Technical Notes shall not relieve the contractor from his responsibility to comply with the most stringent requirements of the contract documents.
- C. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E119 by a testing and inspection agency, by equivalent concrete masonry thickness, or by other means, as acceptable to authorities having jurisdiction.
- D. 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.

## 1.7 MOCK-UPS

- A. Construct a masonry wall as a mock-up panel sized 4 feet long by 4 feet high; include mortar, accessories, structural backup, wall openings, flashings (with lap joint, corner, and end dam), weather barrier, and wall insulation in mock-up.
- B. Architect may select up to 4 different mortar color samples to match existing for installation within mock-up wall.
- C. Locate on pallet (for ease of moving on site), and face the clay brick to the east, aligned to the building facade. Coordinate location of pallet with Architect.
- D. Mock-up may not remain as part of work.
- E. Remove mock-up and dispose of debris when directed to do so by Architect.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials. 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 pre-blended, dry mortar mix in moisture-resistance containers designed for lifting and emptying into dispensing silo. Store pre-blended, 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.

## 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 the stated tolerances, will be exposed in the completed Work or will impair the quality of completed masonry.

### 2.2 CONCRETE MASONRY UNITS

- A. Concrete Block: Comply with referenced standards and as follows:
  - 1. Size: Standard units with nominal face dimensions of 16 x 8 inches (400 x 200 mm) and nominal depth of as indicated on drawings for specific locations. Manufacture to dimensions 3/8" less than nominal dimensions.
  - 2. Special Shapes: Provide non-standard blocks configured for corners, lintels, and other detailed conditions.
    - a. Provide bullnose units for outside corners.
  - 3. Concrete Masonry Units: ASTM C90, normal weight, 3250 psi Net Area Compressive Strength of Masonry, to achieve f'm = 2500 psi.
    - a. Determine net-area compressive strength (f'm) of masonry from average net-area compressive strengths of masonry units and mortar types (unit strength method) according to Table 2 in TMS 402/602.
    - b. Hollow block, as indicated.
    - c. Exposed Faces: Manufacturer's standard color and texture where indicated where indicated.
    - d. Provide factory-created radius edge units for exposed corners at interior masonry. Field gridding to achieve the radius corner will not be accepted.

### 2.3 BRICK UNITS

- A. Manufacturers:
  - 1. GlenGery Brick; [www.glengery.com](http://www.glengery.com).
- B. Facing Brick: ASTM C216, Type FBS Smooth, Grade SW.
  - 1. Color and texture: Adel Brown Velour.
  - 2. Nominal size: Utility.
  - 3. Contact: Dana Ditzenberger - Glen Gery: (319) 350-3987.
  - 4. Special shapes: Molded units as required by conditions indicated, unless standard units can be sawn to produce equivalent effect.

### 2.4 MORTAR AND GROUT MATERIALS

- A. Masonry Cement: ASTM C91/C91M, Type S.
  - 1. Colored Mortar: Premixed cement as required to match Architect/Engineer's color sample.
- B. Portland Cement: ASTM C150/C150M, Type I; color as required to produce approved color sample.

- C. Portland Cement-Lime Mix: Package blend of Portland cement complying with ASTM C150/C150M, Type I; and hydrated lime complying with ASTM C207, Type S
- D. Mortar Aggregate: ASTM C144.
  - 1. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- E. Grout Aggregate: ASTM C404.
- F. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.
  - 1. Color(s): Match Existing.
- G. Water: Clean and potable.
- H. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

## 2.5 REINFORCEMENT AND ANCHORAGE

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 - 60,000 psi (420 MPa), deformed billet bars; uncoated.
- B. Joint Reinforcement: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.
- C. Single Wythe Joint Reinforcement: ASTM A951/A951M.
  - 1. Type: Truss or ladder.
  - 2. Interior Walls: ASTM A1064/A1064M steel wire, mill galvanized to ASTM A641/A641M Class 3
  - 3. Exterior Walls: ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to ASTM A153/A153M Class B
  - 4. Size: 0.1483 inch (3.8 mm) side rods with 0.1483 inch (3.8 mm) cross rods; width as required to provide not more than 1 inch (25 mm) and not less than 5/8 inch (16 mm) of mortar coverage on each exposure.
  - 5. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches on center.
  - 6. Provide in lengths of not less than 10 feet with prefabricated corner and tee units.
- D. Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A153/A153M Class B.
  - 1. Anchor plates: Not less than 0.075 inch (1.91 mm) thick, designed for fastening to structural backup through sheathing by two fasteners.
  - 2. Wire ties: Manufacturer's standard shape, 0.1875 inch (4.75 mm) thick.
  - 3. Vertical adjustment: Not less than 3-1/2 inches (89 mm).
  - 4. Location: Non-Insulated, interior masonry walls.
- E. Clay Masonry Veneer Anchors: Adjustable thermal veneer 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A153/A153M Class B.
  - 1. Manufacturers:
    - a. Hohmann & Barnard: Thermal Concrete 2-Seal Wing Nut Ancho with 2X Hook
  - 2. Location: Exterior masonry walls.

## 2.6 FLASHINGS

### A. Metal Flashing Materials:

1. Stainless Steel Flashing: ASTM A666, Type 304, soft temper; 26 gauge, 0.0187 inch (0.48 mm) thick; finish 2B to 2D.
  - a. Extend 1/2" out from face of wall, with this 1/2" bent down 30 degrees and hemmed to form a drip.
  - b. Provide pre-fabricated corner pieces.
  - c. Lap thru-wall membrane flashing down over the drip plate to within 1 inch of exterior face of wall.
  - d. Adhere flashing continuously to the drip plate.

### B. Termination Bars: Stainless steel; compatible with membrane and adhesives.

### C. Drip Edge: Stainless steel; angled drip with hemmed edge; compatible with membrane and adhesives.

1. Gauge: 26 Stainless Steel
2. Extend 1/2" out from face of wall, with the 1/2" bent down 30 degrees and hemmed to form a drip.
3. Provide pre-fabricated corner pieces. Lap thru-wall membrane flashing down over the drip plate to within 1 inch of exterior face of wall. Adhere flashing continuously to the drip edge.
4. Lap Sealants and Tapes: As recommended by flashing manufacturer; compatible with membrane and adhesives.

## 2.7 ACCESSORIES

### A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.

### B. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.

### C. Weeps & Cavity Vents: Molded PVC grilles, insect resistant, UV-resistant, full height and width of head joints and depth 1/8 inch less the depth of the outer wythe.

1. Color: As selected by Architect from manufacturer's full range.

### D. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

## 2.8 LINTELS

### A. Bond Beams: Prefabricated masonry lintels made from bond beam shaped concrete masonry units matching height, depth and width of rest of masonry of which units are in. Temporarily support built-in-place lintels until cured. Where bottom of units are exposed to view, units shall have enclosed bottoms

### B. Prefabricated Steel Lintels: Refer to 05 12 00 - STRUCTURAL STEEL FRAMING or 05 50 00 - Metal Fabrications.

## 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-lime mortar unless otherwise indicated.
- B. Preblended Dry Mortar Mix: Furnish dry mortar ingredients in form of a pre-blended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide the required compressive strength of masonry.
  - 1. Masonry below grade and in contact with earth: Type M.
  - 2. Exterior, loadbearing masonry: Type S.
  - 3. Interior, loadbearing masonry: Type S.
  - 4. Clay masonry: Type N.
- D. Colored Mortar: Proportion selected pigments and other ingredients to match Architect/Engineer's sample, without exceeding manufacturer's recommended pigment-to-cement ratio.
- E. Grout: ASTM C476; consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches (50 mm) or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches (50 mm).
- F. Admixtures: Add to mixture at manufacturer's recommended rate and in accordance with manufacturer's instructions; mix uniformly.
- G. Mixing: Thoroughly mix ingredients using mechanical batch mixer in accordance with ASTM C270.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other sections are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work. Verify rough-in locations for piping systems and verify actual locations of piping connections.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.



### 3.3 COLD AND HOT WEATHER REQUIREMENTS

- A. Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

### 3.4 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Concrete Masonry Units:
  - 1. Bond: Running.
  - 2. Coursing: One unit and one mortar joint to equal 8 inches (200 mm).
  - 3. Mortar Joints: Concave.
- D. Brick Units:
  - 1. Bond: Running; match existing clay brick bonding.
  - 2. Coursing: match existing clay brick.
  - 3. Mortar Joints: Concave.

### 3.5 INSTALLATION, GENERAL

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and where possible, at other locations.
- B. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges.
- C. Lay concealed masonry with all units in a wythe in running bond. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4 inch (100 mm) horizontal face dimensions at corners or jambs.
- D. Build chases and recesses to accommodate items specified in this and other Sections.
- E. Leave openings for equipment to be installed before completing masonry including installing required lintels. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- F. 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.
- G. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq in per minute when tested per ASTM C67/C67M. Allow nits to absorb water so they are damp but not wet at time of laying.
- H. Fill cores in hollow CMUs with grout 24 inch (600 mm) 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
  - 1. Fill cores in hollow concrete masonry units with grout so there is a minimum of twice the embedment length of solid concrete around all expansion bolts, expansion flush anchors, and bolts installed in masonry.
- I. All new and/or salvaged masonry to be "toothed-in" to existing masonry at exposed locations.

J. Reinforce, grout full, and brace top of 4" CMU walls.

### 3.6 PLACING AND BONDING

- A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- B. Lay hollow concrete masonry units as follows:
  - 1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
  - 2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
  - 3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
  - 4. With entire units, including area under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
  - 5. Joint width: 3/8 inch.
- C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- D. Remove excess mortar and mortar smears as work progresses.
- E. Interlock intersections and external corners.
- F. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- G. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- H. Tooling: Joints shall be struck flush, and, after mortar has set to thumbprint hard, tool joints with a tool which compacts mortar and presses excess mortar out of joint rather than dragging it out. Joints shall be made with a straight clean line. Joints shall be the following:
  - 1. Provide concave joints at all locations not indicated otherwise.
  - 2. Provide raked joints at exposed interior scored concrete masonry, except where other joints are specified.
  - 3. Inside corners are to be raked out and sealant installed at all locations where CMU walls butt adjacent CMU walls.
  - 4. Cut mortar joints flush where wall tile is scheduled, resilient base is scheduled, or inside masonry wall cavities.

### 3.7 REINFORCED UNIT MASONRY INSTALLATION

- A. Placing Reinforcement: Comply with requirements in TMS 402/602.
- B. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
  - 1. Comply with requirements in TMS 402/602 for cleanouts and for grout placement, including minimum grout space, maximum pour height, and maximum lift heights.
  - 2. Where the following conditions are met, place grout in lifts not exceeding 12 ft 8 inches.
    - a. Masonry has cured for at least 4 hours.
    - b. The grout slump is maintained between 10 and 11 inches.
    - c. No intermediate bond beams are placed between the top and bottom of the pour height.

- d. Cleanouts are required when the grout pour height is greater than 5 feet-4 inches.
- e. If the above conditions are not met, place grout in lifts not exceeding 5 feet- 4 inches.

### 3.8 WEEPS/CAVITY VENTS

- A. Install weeps in veneer and cavity walls at 24 inches (600 mm) on center horizontally on top of through-wall flashing above shelf angles and lintels and at bottom of walls.
- B. Install cavity vents in veneer and veneer walls at 24 inches (600 mm) on center horizontally near top of walls and near top of walls.

### 3.9 CAVITY MORTAR CONTROL

- A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.
- B. Apply air barrier to face of backup wythe.
- C. Install Cavity-Wall Insulation to comply with Section 07 21 00 - Thermal Insulation.

### 3.10 REINFORCEMENT AND ANCHORAGE - SINGLE WYTHER MASONRY AND CAVITY WALL MASONRY

- A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches (400 mm) on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches (400 mm) each side of opening.
- C. Place continuous joint reinforcement in first and second joint below top of walls.
- D. Embed longitudinal wires of joint reinforcement in mortar joint with at least 5/8 inch (16 mm) mortar cover on each side.
- E. Lap joint reinforcement ends minimum 6 inches (150 mm).
- F. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- G. Provide continuity at wall intersections by using prefabricated T-shaped units.
- H. Provide continuity at corners by using prefabricated L-shaped units.
- I. Cut and bend reinforcing bars as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

### 3.11 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER

- A. Masonry Back-Up: Embed anchors to bond veneer at maximum 16 inches (400 mm) on center vertically and 36 inches (900 mm) on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches (200 mm) on center.

### 3.12 MASONRY FLASHINGS

- A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
  - 1. Extend flashings full width at such interruptions and at least 6 inches (152 mm), minimum, into adjacent masonry or turn up flashing ends at least 1 inch (25.4 mm), minimum, to form watertight pan at non masonry construction.
  - 2. Remove or cover protrusions or sharp edges that could puncture flashings.

3. Seal lapped ends and penetrations of flashing before covering with mortar.
- B. Terminate flashing up 8 inches (203 mm) minimum on vertical surface of backing:
  1. Install vertical leg of flashing over fluid-applied or self-adhered air/vapor barriers over backing or per manufacturer's directions.
  2. Anchor vertical leg of flashing into backing with a termination bar and sealant.
- C. Install flashing in accordance with manufacturer's instructions and BIA Technical Notes No. 7.

### 3.13 LINTELS

- A. Install loose steel or masonry lintels over openings per the Lintel Schedule(s) on drawings. Provide lintels at all openings of more than 10 inches for brick-sized units and 12 inches for block-size units.
- B. Maintain minimum 8 inch (200 mm) bearing on each side of opening.
- C. Install sealant in lieu of mortar in horizontal joints at bearing ends of exterior steel lintels.

### 3.14 GROUTED COMPONENTS

- A. Reinforce bond beams with 2, No. 5 (M16) bars, 1 inch (25 mm) from bottom web.
- B. Lap splices minimum as indicated on drawings.
- C. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch (13 mm) of dimensioned position.
- D. Place and consolidate grout fill without displacing reinforcing.
- E. At bearing locations, fill masonry cores with grout for a minimum 12 inches (300 mm) either side of opening.

### 3.15 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. Do not continue horizontal joint reinforcement through control joints.
- C. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.
- D. Form expansion joint as detailed on drawings.

### 3.16 BUILT-IN WORK

- A. As work progresses, install built-in metal door frames and glazed frames and other items to be built into the work and furnished under other sections.
  1. Build masonry around metal frames and install anchoring devices supplied by frame manufacturer. Set masonry units tight against frames. Fill hollow metal frame jambs and heads with grout. Set steel lintels in bed of mortar to adjust height to fit tight to top of frame.
- B. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.

### 3.17 TOLERANCES

- A. Install masonry within the site tolerances found in TMS 402/602.

- B. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft (6 mm/3 m) and 1/2 inch in 20 ft (13 mm/6 m) or more.
- C. Maximum Variation from Plumb: 1/4 inch (6 mm) per story non-cumulative; 1/2 inch (13 mm) in two stories or more.
- D. Maximum Variation from Level Coursing: 1/8 inch in 3 ft (3 mm/m) and 1/4 inch in 10 ft (6 mm/3 m); 1/2 inch in 30 ft (13 mm/9 m).
- E. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch (minus 6.4 mm, plus 9.5 mm).

### 3.18 CUTTING AND FITTING

- A. Cut and fit for chases. Coordinate with other sections of work to provide correct size, shape, and location.

### 3.19 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests.
- B. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at s expense.
- C. Concrete Masonry Unit Tests: Test each variety of concrete unit masonry in accordance with ASTM C140/C140M for compliance with requirements of this specification.
- D. Grout Test (Compressive Strength): For each mix provided, according to ASTM C1019.
- E. Mortar does not need to be tested as they are specified by proportions.

### 3.20 CLEANING AND REPAIR

- A. Remove excess mortar, mortar smears and mortar droppings.
- B. Replace defective mortar. Match adjacent work in color and joint profile.
- C. Remove and replace masonry units which are loose, chipped, broken, stained or otherwise damaged. Provide new units to match adjoining units and install in fresh mortar and grout pointed and with same mortar color to eliminate evidence of replacement.
- D. Prior to end of the standard building guarantee period, all cracked, and otherwise defective masonry work shall be repaired.
- E. Clean soiled surfaces with cleaning solution. Protect adjacent or dissimilar materials from damage from cleaning activities.
- F. Use non-metallic tools in cleaning operations.
- G. Contractor shall be responsible for protection of masonry cavity from construction debris and trash. Inspect cavity prior to continuation of wall construction to verify debris has not been dropped or blown-in during breaks or stoppage in work.

### 3.21 PROTECTION

- A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.
- B. Provide sand or pea gravel mulch at base of wall or plastic sheathing up face of finished masonry at base of wall to protect lower masonry from mud, mortar droppings and staining from uncompleted construction operations.

- C. Provide protective cover and rigid boards or panels at opening sills to deflect mortar droppings and dropped objects from damaging masonry sills or any other projecting elements.
- D. During construction of walls, cover tops of walls and any open sills or headers with waterproof sheeting at the end of each day's work. Cover partially completed masonry when construction is not in progress.
  - 1. Extend cover a minimum of 24 inches down face of both sides of wall and hold cover securely in place.
  - 2. Where 1 wythe of multi-wythe masonry is completed in advance of other wythes, secure cover sheeting down face of higher wythe and a minimum of 24 inches down face of lower or unconstructed wythe and hold securely in place.
  - 3. Direct cavity and masonry wythe covers to drain to exterior of building or when at interior partitions, to unfinished areas whenever possible.

### 3.22 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.
- B. Excess Masonry Waste: Remove excess clean masonry waste. Masonry waste cannot be used as fill. Legally dispose of off Owner's property.

**END OF SECTION**

SECTION 04 72 00  
CAST STONE MASONRY

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Architectural Precast Concrete Sills.

1.2 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- B. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2018.
- C. ASTM C150/C150M - Standard Specification for Portland Cement; 2019a.
- D. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019.
- E. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2017.
- F. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2016.
- G. ASTM C1364 - Standard Specification for Architectural Cast Stone; 2023.

1.3 SUBMITTALS

- A. Product Data: Test results of cast stone components made previously by the manufacturer.
- B. Shop Drawings: Include elevations, dimensions, layouts, profiles, cross sections, reinforcement, exposed faces, arrangement of joints, anchoring methods, anchors, and piece numbers. Cut ends will not be accepted.
- C. Mortar Color Selection Samples.
- D. Verification Samples: Pieces of actual cast stone components not less than 6 inches (152 mm) square, illustrating range of color and texture to be anticipated in components furnished for the project.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
  - 1. A firm with a minimum of 5 years experience producing cast stone of types required for project.
  - 2. Current producer member of the Cast Stone Institute or the Architectural Precast Association.
  - 3. Adequate plant capacity to furnish quality, sizes, and quantity of cast stone required without delaying progress of the work.

1.5 MOCK-UP

- A. Mock-Up: Provide full size cast stone components for installation in mock-up of exterior wall.
- B. See Section 01 40 00 - Quality Requirements for additional requirements.
  - 1. Approved mock-up will become standard for appearance and workmanship.
  - 2. Mock-up may not remain as part of the completed work.

3. Remove mock-up not incorporated into the work and dispose of debris.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver cast stone components secured to shipping pallets and protected from damage and discoloration. Protect corners from damage.
- B. Store cast stone components and installation materials in accordance with manufacturer's instructions.
- C. Store cast stone components on pallets with nonstaining, waterproof covers. Ventilate under covers to prevent condensation. Prevent contact with dirt.
- D. Protect cast stone components during handling and installation to prevent chipping, cracking, or other damage.
- E. Store mortar materials where contamination can be avoided.
- F. Schedule and coordinate production and delivery of cast stone components with unit masonry work to optimize on-site inventory and to avoid delaying the work.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Architectural Cast Stone:
  1. Any current producer member of the Architectural Precast Association.
  2. Any current producer member of the Cast Stone Institute.

### 2.2 ARCHITECTURAL CAST STONE

- A. Cast Stone: Architectural concrete product manufactured to simulate appearance of natural granite, complying with ASTM C1364.
  1. Compressive Strength: As specified in ASTM C1364; calculate strength of pieces to be field cut at 80 percent of uncut piece.
  2. Freeze-Thaw Resistance: Demonstrated by laboratory testing in accordance with ASTM C1364.
  3. Surface Texture: Fine grained texture, with no bugholes, air voids, or other surface blemishes visible from distance of 20 feet (6 meters).
  4. Color: Match existing.
  5. Remove cement film from exposed surfaces before packaging for shipment.
- B. Shapes: Match existing shapes.
  1. Variation from Any Dimension, Including Bow, Camber, and Twist: Maximum of plus/minus 1/8 inch (3 mm) or length divided by 360, whichever is greater, but not more than 1/4 inch (6 mm).
  2. Unless otherwise indicated on drawings, provide:
    - a. Wash or slope of 1:12 on exterior horizontal surfaces.
    - b. Drips on projecting components, wherever possible.
    - c. Raised fillets at back of sills and at ends to be built in.
- C. Reinforcement: Provide reinforcement as required to withstand handling and structural stresses; comply with ACI 318.



1. Pieces More than 24 inches (610 mm) in Any Dimension: Provide full length two-way reinforcement of cross-sectional area not less than 0.25 percent of unit cross-sectional area.

## 2.3 MATERIALS

- A. Portland Cement: ASTM C150.
- B. Coarse Aggregate: ASTM C33/C33M, except for gradation; granite, quartz, or limestone.
- C. Fine Aggregate: ASTM C33/C33M, except for gradation; natural or manufactured sands.
- D. Pigments: ASTM C979, inorganic iron oxides; do not use carbon black.
- E. Admixtures: ASTM C494/C494M.
- F. Water: Potable.
- G. Reinforcing Bars: ASTM A615/A615M deformed bars, galvanized.
- H. Mortar: Portland cement-lime, as specified in Section 04 05 11 ; do not use masonry cement.
- I. Sealant: As specified in Section 07 90 05.
- J. Cleaner: General-purpose cleaner designed for removing mortar and grout stains, efflorescence, and other construction stains from new masonry surfaces without discoloring or damaging masonry surfaces; approved for intended use by cast stone manufacturer and by cleaner manufacturer for use on cast stone and adjacent masonry materials.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine construction to receive cast stone components. Notify Architect/Engineer if construction is not acceptable.
- B. Do not begin installation until unacceptable conditions have been corrected.

### 3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install cast stone components in conjunction with masonry, complying with requirements of Section 04 20 00.
- C. Mechanically anchor cast stone units indicated; set remainder in mortar.
- D. Setting:
  1. Drench cast stone components with clear, running water immediately before installation.
  2. Set units in a full bed of mortar unless otherwise indicated.
  3. Fill vertical joints with mortar.
  4. Fill dowel holes and anchor slots completely with mortar or non-shrink grout.

### 3.3 TOLERANCES

- A. Joints: Make all joints 3/8 inch (9.5 mm), except as otherwise detailed.
  1. Rake mortar joints 3/4 inch (19 mm) for pointing.
  2. Remove excess mortar from face of stone before pointing joints.

3. Point joints with mortar in layers 3/8 inch (9.5 mm) thick and tool to a slight concave profile.
- B. Sealant Joints: Install sealants as specified in Section 07 90 05.

#### 3.4 REPAIR

- A. Repairs: Repair chips and other surface damage noticeable when viewed in direct daylight at 20 feet (6 m).
  1. Repair with matching touchup material provided by the manufacturer and in accordance with manufacturer's instructions.
  2. Repair methods and results subject to Architect/Engineer 's approval.

#### 3.5 CLEANING

- A. Keep cast stone components clean as work progresses.
- B. Clean completed exposed cast stone after mortar is thoroughly set and cured.
  1. Wet surfaces with water before applying cleaner.
  2. Apply cleaner to cast stone in accordance with manufacturer's instructions.
  3. Remove cleaner promptly by rinsing thoroughly with clear water.
  4. Do not use acidic cleaners.

#### 3.6 PROTECTION

- A. Protect completed work from damage.
- B. Clean, repair, or restore damaged or mortar-splashed work to condition of new work.

**END OF SECTION**

SECTION 05 12 00  
STRUCTURAL STEEL FRAMING

**PART 1 GENERAL**

1.1 SUMMARY

- A. Section Includes:
  - 1. Structural steel.

1.2 REFERENCE STANDARDS

- A. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges; 2010.
- B. AISC 360 - Specification for Structural Steel Buildings; 2016.
- C. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished; 2018.
- D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- E. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- F. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2018.
- G. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2018.
- H. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts; 2021a.
- I. ASTM A563M - Standard Specification for Carbon and Alloy Steel Nuts (Metric); 2021a.
- J. ASTM A6/A6M - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling; 2017.
- K. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2009 (Reapproved 2015).
- L. ASTM A992/A992M - Standard Specification for Structural Steel Shapes; 2022.
- M. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2017.
- N. ASTM E164 - Standard Practice for Contact Ultrasonic Testing of Weldments; 2019.
- O. ASTM E165/E165M - Standard Practice for Liquid Penetrant Testing for General Industry; 2023.
- P. ASTM E709 - Standard Guide for Magnetic Particle Testing; 2021.
- Q. ASTM E94 - Standard Guide for Radiographic Examination; 2004 (Reapproved 2010).
- R. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength; 2018.
- S. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2019.
- T. ASTM F436/F436M - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions; 2019.

- U. ASTM F959 - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners; 2013.
- V. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015, with Errata (2016).
- W. AWS D1.8/D1.8M - Structural Welding Code - Seismic Supplement; 2016.
- X. RCSC (HSBOLT) - Specification for Structural Joints Using High-Strength Bolts; Research Council on Structural Connections; 2020.
- Y. SSPC-PA 1 - Shop, Field, and Maintenance Coating of Metals; 2016.
- Z. SSPC-PS Guide 7.00 - Guide for Selecting One-Coat Shop Painting Systems; 1982.
- AA. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).
- BB. SSPC-SP 2 - Hand Tool Cleaning; 2018.
- CC. SSPC-SP 3 - Power Tool Cleaning; 2018.

### 1.3 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303.

### 1.4 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show fabrication of structural-steel components.
  1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
  2. Include embedment drawings.
  3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
  4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.

### 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Fabricator.
- B. Product Test Reports: For the following:
  1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
  2. Direct-tension indicators.
  3. Tension-control, high-strength, bolt-nut-washer assemblies.
  4. Shear stud connectors.
  5. Shop primers.

- C. Field quality-control and special inspection reports.

## 1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU (certified building fabricator) at the time of bidding.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Comply with applicable provisions of the following specifications and documents:
  - 1. AISC 303 "Code of Standard Practice for Steel Buildings and Bridges".
  - 2. AISC 360 "Specification for Structural Steel Buildings".
  - 3. RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts".

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
  - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
  - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
  - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
  - 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade 1852 fasteners and for retesting fasteners after lubrication.

## PART 2 PRODUCTS

### 2.1 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A992/A992M.
- B. Channels, Angles, M or S-Shapes: ASTM A36/A36M.
- C. Plate and Bar: ASTM A36/A36M.
- D. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade C, structural tubing.
- E. Welding Electrodes: Comply with AWS requirements.

### 2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade C (ASTM A563M, Class 8S) heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
  - 1. Direct-Tension Indicators: ASTM F959 Type 325 (Type 8.8), compressible-washer type with plain finish.

- B. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563 Grade DH (A563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
  - 1. Finish: Hot-dip zinc coating.
  - 2. Direct-Tension Indicators: ASTM F959, Type 325 (Type 8.8), compressible-washer type with mechanically deposited zinc coating finish.
- C. Shear Connectors: ASTM A108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.
- D. Headed Anchor Rods: ASTM F1554 grade 36, straight.
  - 1. Nuts: ASTM A563 (ASTM A563M) heavy-hex carbon steel.
  - 2. Plate Washers: ASTM A36/A36M carbon steel.
  - 3. Washers: ASTM F436/F436M, Type 1, hardened carbon steel.
  - 4. Finish: Plain.

### 2.3 PRIMER

- A. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.
- B. Galvanizing Repair Paint: ASTM A780/A780M.

### 2.4 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303 and AISC 360.
  - 1. Camber structural-steel members where indicated.
  - 2. Fabricate beams with rolling camber up.
  - 3. Identify high-strength structural steel according to ASTM A6/A6M and maintain markings until structural steel has been erected.
  - 4. Mark and match-mark materials for field assembly.
  - 5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
  - 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- C. Bolt Holes: Cut, drill, or punch standard, oversized, or slotted bolt holes as indicated on drawings, perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1
- F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.
- G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
  - 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.

2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

## 2.5 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
  1. Joint Type: Snug tightened, unless indicated otherwise on drawings.
- B. Weld Connections: Comply with AWS D1.1/D1.1M and ASTM C150/C150M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
  1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

## 2.6 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
  1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inch (50 mm).
  2. Surfaces to be field welded.
  3. Surfaces of high-strength bolted, slip-critical connections.
  4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
  5. Galvanized surfaces.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
  1. SSPC-SP 2, "Hand Tool Cleaning."
  2. SSPC-SP 3, "Power Tool Cleaning."
- C. Painting: Prepare steel and apply a one-coat, nonasphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils (0.038 mm).

## 2.7 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A123/A123M.
  1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
  2. Galvanize lintels and shelf angles attached to structural-steel frame and located in exterior walls.
  3. Galvanize items indicated to be galvanized on Drawings.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify, with steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
  - 1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

### **3.3 ERECTION**

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Baseplates, Bearing Plates, and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
  - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
  - 2. Weld plate washers to top of baseplate.
  - 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
  - 4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel within AISC 303.
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
  - 1. Level and plumb individual members of structure.
  - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.



### 3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
  - 1. Joint Type: Snug tightened, unless indicated otherwise on drawings.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
  - 1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
  - 2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
  - 3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

### 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
  - 1. Bolted Connections: Inspect and test bolted connections according to RCSC's "Specification for Structural Joints Using High-Strength Bolts".
  - 2. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.
    - a. In addition to visual inspection, test and inspect field welds according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
      - 1) Liquid Penetrant Inspection: ASTM E165/E165M.
      - 2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
      - 3) Ultrasonic Inspection: ASTM E164.
      - 4) Radiographic Inspection: ASTM E94.
  - 3. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

### 3.6 REPAIRS AND PROTECTION

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A780/A780M.
- B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
  - 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

**END OF SECTION**

SECTION 05 21 00  
STEEL JOIST FRAMING

**PART 1 GENERAL**

1.1 SUMMARY

- A. Section Includes:
  - 1. K-series steel joists.
  - 2. Joist accessories.
- B. Related Requirements:
  - 1. Section 04 2000 "Unit Masonry" for installing bearing plates in unit masonry.

1.2 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- B. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2014, with Editorial Revision (2017).
- C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- D. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts; 2021a.
- E. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2009 (Reapproved 2015).
- F. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel; 2004.
- G. ASTM E164 - Standard Practice for Contact Ultrasonic Testing of Weldments; 2019.
- H. ASTM E165/E165M - Standard Practice for Liquid Penetrant Testing for General Industry; 2023.
- I. ASTM E709 - Standard Guide for Magnetic Particle Testing; 2021.
- J. ASTM E94 - Standard Guide for Radiographic Examination; 2004 (Reapproved 2010).
- K. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2019.
- L. ASTM F436 - Standard Specification for Hardened Steel Washers; 2011.
- M. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015, with Errata (2016).
- N. SJI (SPEC) - Catalog of Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders; 2011.
- O. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.
- P. SSPC-SP 2 - Hand Tool Cleaning; 2018.
- Q. SSPC-SP 3 - Power Tool Cleaning; 2018.

### 1.3 DEFINITIONS

- A. SJI (SPEC): Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders", 2011.
- B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support nonuniform, unequal, or special loading conditions that invalidate load tables in SJI (SPEC).

### 1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated.
  - 1. Use ASD; data are given at service-load level.
  - 2. Design special joists to withstand design loads with live-load deflections no greater than the following:
    - a. Roof Joists: Vertical deflection of 1/360 of the span.

### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of joist, accessory, and product.
- B. Shop Drawings:
  - 1. Include layout, designation, number, type, location, and spacing of joists.
  - 2. Include joining and anchorage details, bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.
  - 3. Indicate locations and details of bearing plates to be embedded in other construction.

### 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Welding certificates.
- C. Manufacturer certificates.
- D. Field quality-control and special inspection reports
- E. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.

### 1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI (SPEC).
  - 1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.
- B. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle joists as recommended in SJI (SPEC).
- B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

## 1.9 SEQUENCING

- A. Deliver steel bearing plates to be built into cast-in-place concrete and masonry construction.

## PART 2 PRODUCTS

### 2.1 K-SERIES STEEL JOISTS

- A. Manufacture steel joists of type indicated according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI (SPEC), with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.
  - 1. Joist Type: K-series steel joists and KCS-type K-series steel joists.
- B. Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI (SPEC), with steel-angle or -channel members.
- C. Provide holes in chord members for connecting and securing other construction to joists.
- D. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated, complying with SJI (SPEC).
- E. Camber joists according to SJI (SPEC), unless indicated otherwise on drawings.
- F. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches (1:48).

### 2.2 PRIMERS

- A. Primer: SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.

### 2.3 JOIST ACCESSORIES

- A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI (SPEC) and OSHA regulations for type of joist, chord size, spacing, span and uplift design loading. Furnish additional erection bridging if required for stability.
- B. Fabricate steel bearing plates from ASTM A36/A36M steel with integral anchorages of sizes and thicknesses indicated. Shop prime paint.
- C. Carbon-Steel Bolts and Threaded Fasteners: ASTM A307, Grade A, carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers.
  - 1. Finish: Plain, uncoated.
- D. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy hex steel structural bolts; ASTM A563 heavy hex carbon-steel nuts; and ASTM F436 hardened carbon-steel washers.
  - 1. Finish: Plain.
- E. Welding Electrodes: Comply with AWS standards.
- F. Galvanizing Repair Paint: ASTM A780/A780M.
- G. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

### 2.4 CLEANING AND SHOP PAINTING

- A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.

- B. Do not prime paint joists and accessories to receive sprayed fire-resistive materials.
- C. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil (0.025 mm) thick.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION**

- A. Do not install joists until supporting construction is in place and secured.
- B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI (SPEC), Joist manufacturer's written recommendations, and requirements in this Section.
  - 1. Before installation, splice joists delivered to Project site in more than one piece.
  - 2. Space, adjust, and align joists accurately in location before permanently fastening.
  - 3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
  - 4. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads are applied.
- C. Field weld joists to supporting steel bearing plates and framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
- D. Bolt joists to supporting steel framework using carbon-steel bolts.
- E. In steel frames, where columns are not framed in at least two directions with structural steel members, bolt joists at column lines to supporting steel framework using bolts.
- F. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

#### **3.3 FIELD QUALITY CONTROL**

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and bolted connections and to perform field tests and inspections and prepare test and inspection reports.
- B. Visually inspect field welds according to AWS D1.1/D1.1M.
  - 1. In addition to visual inspection, test field welds according to AWS D1.1/D1.1M and the following procedures, as applicable:
    - a. Liquid Penetrant Inspection: ASTM E165/E165M.
    - b. Magnetic Particle Inspection: ASTM E709.
    - c. Ultrasonic Testing: ASTM E164.

- d. Radiographic Testing: ASTM E94.
- C. Visually inspect bolted connections.
- D. Correct deficiencies in Work that test and inspection reports have indicated are not in compliance with specified requirements.
- E. Perform additional testing to determine compliance of corrected Work with specified requirements.

#### 3.4 PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.
- B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists, bearing plates, abutting structural steel, and accessories.
  - 1. Clean and prepare surfaces by hand-tool cleaning according to SSPC-SP 2, or power-tool cleaning according to SSPC-SP 3.
  - 2. Apply a compatible primer of same type as primer used on adjacent surfaces.
- C. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that joists and accessories are without damage or deterioration at time of Substantial Completion.

**END OF SECTION**

SECTION 05 31 00  
STEEL DECKING

**PART 1 GENERAL**

1.1 SUMMARY

A. Section Includes:

1. Roof deck.

1.2 REFERENCE STANDARDS

- A. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2018.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- C. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2009 (Reapproved 2015).
- D. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
- E. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection and/or Testing; 2014a.
- F. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018.

1.3 PERFORMANCE REQUIREMENTS

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
- B. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of deck, accessory, and product indicated.
- B. Shop Drawings:
  1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.5 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Product Certificates: For each type of steel deck.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
  1. Power-actuated mechanical fasteners.
- D. Evaluation Reports: For steel deck.

E. Field quality-control and special inspection reports.

## 1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.
  - 1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

## PART 2 PRODUCTS

### 2.1 ROOF DECK

- A. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
  - 1. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 33 ksi (230 MPa), G60 (Z180) zinc coating.
  - 2. Deck Profile: Type WR, wide rib.
  - 3. Profile Depth: As indicated.
  - 4. Design Uncoated-Steel Thickness: As indicated.
  - 5. Span Condition: Triple span or more.
  - 6. Side Laps: Overlapped

### 2.2 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 (4.8 mm) minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), not less than 0.0359 inch (0.91 mm) design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.
- G. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck. For drains, cut holes in the field.



- H. Galvanizing Repair Paint: ASTM A780/A780M.
- I. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION, GENERAL**

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.
- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
  - 1. Reinforce deck openings from 6 in to 18 in in size with 2"x2"x1/4" steel angles. Place framing angles perpendicular to flutes; extend minimum of two flutes beyond each side of opening and weld to deck at each flute.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

#### **3.3 ROOF-DECK INSTALLATION**

- A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1 1/2 inch (38 mm) long, and as follows:
  - 1. Weld Diameter: as indicated, nominal.
  - 2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds as indicated.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports as indicated
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1 1/2 inch (38 mm), with end joints as follows:
  - 1. End Joints: Lapped 2 inch (51 mm), minimum.

- D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld or mechanically fasten flanges to top of deck. Space welds or mechanical fasteners not more than 12 inch (305 mm) apart with at least one weld or fastener at each corner.
  - 1. Install reinforcing channels or zees in ribs to span between supports and weld or mechanically fasten.
- E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.
  - 1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.
- F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

#### 3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Field welds will be subject to inspection.
- C. Testing agency will report inspection results promptly and in writing to Contractor and Architect/Engineer.
- D. Remove and replace work that does not comply with specified requirements.
- E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

#### 3.5 PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.
- B. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

**END OF SECTION**

SECTION 06 10 00  
ROUGH CARPENTRY

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Nonstructural dimension lumber framing.
- B. Sheathing.
- C. Miscellaneous framing and sheathing.
- D. Communications and electrical room mounting boards.
- E. Concealed wood blocking, nailers, and supports.

1.2 REFERENCE STANDARDS

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- B. PS 20 - American Softwood Lumber Standard; 2021.

**PART 2 PRODUCTS**

2.1 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
  - 1. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.

2.2 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

- A. Sizes: Nominal sizes as indicated on drawings, S4S.
- B. Moisture Content: S-dry or MC19.
- C. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
  - 1. Lumber: S4S, No. 2 or Standard Grade.
  - 2. Boards: Standard or No. 3.

**PART 3 EXECUTION**

3.1 PREPARATION

- A. Where wood framing bears on cementitious foundations, install full width sill flashing continuous over top of foundation, lap ends of flashing minimum of 4 inches (100 mm) and seal.
- B. Install sill gasket under sill plate of framed walls bearing on foundations; puncture gasket cleanly to fit tightly around protruding anchor bolts.
- C. Coordinate installation of rough carpentry members specified in other sections.

### 3.2 INSTALLATION - GENERAL

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

### 3.3 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to authorities having jurisdiction may be used in lieu of solid wood blocking.
- C. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.
- D. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
- E. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

### 3.4 CLEANING

- A. Waste Disposal:
  - 1. Comply with applicable regulations.
  - 2. Do not burn scrap on project site.
  - 3. Do not burn scraps that have been pressure treated.
  - 4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or "waste-to-energy" facilities.
- B. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.
- C. Prevent sawdust and wood shavings from entering the storm drainage system.

**END OF SECTION**

SECTION 06 41 00  
ARCHITECTURAL WOOD CASEWORK

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Specially fabricated cabinet units.
- B. Countertops.
- C. Hardware.

1.2 REFERENCE STANDARDS

- A. ANSI A208.1 - American National Standard for Particleboard; 2022.
- B. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.
- C. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
- D. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
- E. BHMA A156.9 - Cabinet Hardware; 2020.
- F. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.3 SUBMITTALS

- A. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
  - 1. Scale of Drawings: 1-1/2 inch to 1 foot (125 mm to 1 m), minimum.
  - 2. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
- B. Product Data: Provide data for hardware accessories.
- C. Verification Samples: Submit samples minimum 12 inches (300 mm) square, illustrating proposed laminate and solid surfaces substrate and finish.

1.4 QUALITY ASSURANCE

- A. Quality Certification:
  - 1. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: [www.awiqcp.org/#sle](http://www.awiqcp.org/#sle).

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect units from moisture damage.

1.6 FIELD CONDITIONS

- A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

## **PART 2 PRODUCTS**

### **2.1 CABINETS**

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or NAAWS, unless noted otherwise.
- B. Plastic Laminate Faced Cabinets: Custom grade.
- C. Cabinets:
  - 1. Finish - Exposed Exterior Surfaces: Decorative laminate.
  - 2. Finish - Exposed Interior Surfaces: Decorative laminate.
  - 3. Finish - Semi-Exposed Surfaces: Decorative laminate.
  - 4. Finish - Concealed Surfaces: White Melamine.
  - 5. Door and Drawer Front Edge Profiles: Square edge with thick applied band.
  - 6. Door and Drawer Front Retention Profiles: Fixed panel.
  - 7. Casework Construction Type: Type A - Frameless.
  - 8. Grained Face Layout for Cabinet and Door Fronts: Flush panel.
    - a. Custom Grade: Doors, drawer fronts and false fronts wood grain to run and match vertically within each cabinet unit.
  - 9. Adjustable Shelf Loading: 40 psf (19.5 gm/sq cm).
  - 10. Cabinet Style: Flush overlay.
  - 11. Cabinet Doors and Drawer Fronts: Flush style.

### **2.2 WOOD-BASED COMPONENTS**

- A. Wood fabricated from old growth timber is not permitted.

### **2.3 PANEL CORE MATERIALS**

- A. Particleboard: Composite panel composed of cellulosic particles, additives, and bonding system; comply with ANSI A208.1.

### **2.4 LAMINATE MATERIALS**

- A. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.
- B. Provide specific types as indicated.
  - 1. Horizontal Surfaces: HGS, 0.048 inch (1.22 mm) nominal thickness, colors as indicated, textured low gloss finish.
  - 2. Vertical Surfaces: VGS, 0.028 inch (0.71 mm) nominal thickness, colors as indicated, finish as indicated , finish as indicated.
  - 3. Cabinet Liner: CLS, 0.020 inch (0.51 mm) nominal thickness, through color, white color, textured low gloss finish.
  - 4. Laminate Backer: BKL, 0.020 inch (0.51 mm) nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.

### **2.5 STAINLESS STEEL FABRICATED SINK SHROUDS**

- A. 14 guage stainless steel.

## 2.6 COUNTERTOPS

### A. Solid Surface Material:

1. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
2. Flammability: Class 1 and A when tested to UL 723
3. Horizontal application thickness: 1/2".
4. Vertical application thickness: 1/4"
5. Exposed Edge Treatment: Built up to minimum of 1-1/2 " thick, eased edge; marine edge at sinks.
6. Windowsills: 1/2" thick solid surfacing material, adhesively joined with inconspicuous seams, edge details as indicated on Drawings.
7. Integral Backsplash and Custom Fit End Splashes: Same as sheet material, bullnose top edge; minimum 4" high.
  - a. Provide back and side splashes unless noted otherwise in drawings.

## 2.7 ACCESSORIES

- ### A. Plastic Edge Banding: 3mm, flat shaped; smooth finish; of width to match component thickness.
1. Color: to match plastic laminate.
  2. Use at all exposed shelf edges.
  3. Use at plastic laminate door and drawer edges.

## 2.8 HARDWARE

- ### A. Adjustable Shelf Supports: Standard side-mounted system using multiple holes for pin supports and coordinated self rests, for nominal 1 inch (25 mm) spacing adjustments.
1. Nickel Shelf Support Pegs. L-shaped.
- ### B. Drawer and Door Pulls: "U" shaped wire pull, steel with chrome finish, 4 inch centers ("U" shaped wire pull, steel with chrome finish, 100 mm centers).
- ### C. Hinges: European style concealed self-closing type, steel with nickel-plated finish. Integrated soft closing.
1. Manufacturers:
    - a. Basis of Design: Blum, Inc; CLIP top BLUMOTION: [www.blum.com/#sle](http://www.blum.com/#sle).
    - b. Grass America Inc: [www.grassusa.com/#sle](http://www.grassusa.com/#sle).
    - c. Hettich America, LP: [www.hettich.com/#sle](http://www.hettich.com/#sle).
    - d. Substitutions: See Section 01 60 00 - Product Requirements.

## 2.9 FABRICATION

- ### A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
- ### B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.

- C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
- D. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs. (Locate counter butt joints minimum 600 mm from sink cut-outs.)
- E. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify adequacy of backing and support framing.
- B. Verify location and sizes of utility rough-in associated with work of this section.

#### **3.2 INSTALLATION**

- A. Install work in accordance with AWI/AWMAC/WI (AWS) requirements for grade indicated.
- B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
- C. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

#### **3.3 ADJUSTING**

- A. Adjust moving or operating parts to function smoothly and correctly.

#### **3.4 CLEANING**

- A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

**END OF SECTION**



**SECTION 07 05 53  
FIRE AND SMOKE ASSEMBLY IDENTIFICATION**

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Identification markings for fire and smoke rated partitions, and fire rated walls.

1.2 REFERENCE STANDARDS

- A. ICC (IBC) - International Building Code; 2015.

1.3 SUBMITTALS

- A. Schedule: Completely define scope of proposed marking, and indicate location of affected walls and partitions, and number of markings, to be reviewed by Owner.

1.4 FIELD CONDITIONS

- A. Do not install adhered markings when ambient temperature is lower than recommended by label or sign manufacturer.
- B. Do not install painted markings when ambient temperature is lower than recommended by coating manufacturer.

**PART 2 PRODUCTS**

2.1 FIRE AND SMOKE ASSEMBLY IDENTIFICATION

- A. Regulatory Requirements: Comply with "Marking and Identification" requirements of "Fire-Resistance Ratings and Fire Tests" chapter of ICC (IBC).

**PART 3 EXECUTION**

3.1 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.

3.2 INSTALLATION

- A. Locate markings as required by ICC (IBC).
- B. Install neatly, with horizontal edges level.
- C. Protect from damage until Date of Substantial Completion; repair or replace damaged markings.

**END OF SECTION**

SECTION 07 21 00  
THERMAL INSULATION

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Board insulation at cavity wall construction and perimeter foundation wall.
- B. Batt insulation in exterior wall and wall construction.
- C. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

1.2 RELATED REQUIREMENTS

- A. Section 07 26 00 - Vapor Retarders: Separate vapor retarder materials.
- B. Section 07 22 00 - Roof and Deck Insulation: Roof insulation.

1.3 REFERENCE STANDARDS

- A. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2022.
- B. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2017.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- D. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C; 2019a.

1.4 SUBMITTALS

- A. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
- B. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.

1.5 MOCK-UP

- A. Provide insulation in mock-up of exterior wall.

1.6 FIELD CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

**PART 2 PRODUCTS**

2.1 APPLICATIONS

- A. Insulation at Perimeter of Foundation: Extruded polystyrene (XPS) board.
- B. Insulation Inside Masonry Cavity Walls: Extruded polystyrene (XPS) board.

## 2.2 FOAM BOARD INSULATION MATERIALS

- A. Extruded Polystyrene (XPS) Board Insulation: Complies with ASTM C578 with either natural skin or cut cell surfaces.
  - 1. Type and Compressive Resistance: Type IV, 25 psi (173 kPa), minimum.
  - 2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
  - 3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
  - 4. Type and Thermal Resistance, R-value (RSI-value): Type IV, 5.0 (0.88), minimum, per 1 inch (25.4 mm) thickness at 75 degrees F (24 degrees C) mean temperature.
  - 5. Board Thickness: 2-1/2 inches (63 mm).
  - 6. Board Edges: Square.

## 2.3 BATT INSULATION MATERIALS

- A. Where batt insulation is indicated, either glass fiber or mineral fiber batt insulation may be used, at Contractor's option.
- B. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.
  - 1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
  - 2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
  - 3. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
  - 4. Formaldehyde Content: Zero.
  - 5. Thickness: 6 inch (152 mm).
  - 6. Facing: Unfaced.
- C. Mineral Fiber Batt Insulation: Flexible or semi-rigid preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
  - 1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
  - 2. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
  - 3. Provide foil facing on one side, at locations indicated on drawings.
  - 4. Thickness: 6 inch (152 mm).

## 2.4 STRUCTURAL THERMAL BREAK MATERIAL

- A. Thermal break at masonry transitions:
  - 1. Basis of Design: 500-150 Thermal Break Material by Armatherm.
  - 2. Provide at foundation to wall transition as indicated on Drawings.
  - 3. Fasten material to foundation by use of structural screws.
  - 4. Product shall have contiguous contact with other insulation materials.
  - 5. Substitutions: See Section 01 6000
- B. Thermal Break at steel connections:
  - 1. Basis of Design: FRR Thermal Break Material by Armatherm.
  - 2. Provide at steel thermal break connections indicated on the drawings.
  - 3. Substitutions: See Section 01 6000

## 2.5 ACCESSORIES

- A. Tape: Bright aluminum self-adhering type, mesh reinforced, 2 inch (50 mm) wide.
- B. Insulation Fasteners: Appropriate for purpose intended.
- C. Adhesive: Type recommended by insulation manufacturer for application.
- D. Minimal-Expanding Foam Sealant: single component polyurethane foam sealant for general purpose, including gaps in panels, etc. Verify sealant is compatible with rigid board materials.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation and adhesive.
- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

### 3.2 BOARD INSTALLATION AT FOUNDATION PERIMETER

- A. Apply adhesive to back of boards:
  - 1. Three continuous beads per board length.
- B. Install boards horizontally on foundation perimeter.
  - 1. Place boards to maximize adhesive contact.
  - 2. Install in running bond pattern.
  - 3. Butt edges and ends tightly to adjacent boards and to protrusions.
- C. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
- D. Fill gaps between boards with minimal-expanding foam sealant.

### 3.3 BOARD INSTALLATION AT CAVITY WALLS

- A. Install boards to fit snugly between wall ties.
- B. Install boards horizontally on walls.
  - 1. Install in running bond pattern.
  - 2. Butt edges and ends tightly to adjacent boards and protrusions.
- C. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
- D. Seal penetrations and gaps with minimal-expanding foam; tape as required.

### 3.4 BATT INSTALLATION

- A. Install insulation in accordance with manufacturer's instructions.
- B. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- C. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.
- D. Tape insulation batts in place.
- E. Tape seal butt ends, lapped flanges, and tears or cuts in membrane.

3.5 FIELD QUALITY CONTROL

A. Do not cover air barrier work until accepted by Architect.

3.6 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

**END OF SECTION**

SECTION 07 21 60  
STRUCTURAL THERMAL BREAK

**PART 1 GENERAL**

1.1 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section including the following.
  - 1. Structural thermal breaks fabricated from the following material:
    - a. Polyurethane.
  - 2. Thermal breaks at the following locations:
    - a. Masonry Brick on Concrete Foundation Wall.

1.2 RELATED WORK:

- A. THE FOLLOWING ITEMS ARE NOT INCLUDED IN THIS SECTION AND ARE SPECIFIED UNDER THE DESIGNATED SECTIONS:
  - 1. Section 03 30 00 - CAST-IN-PLACE CONCRETE for coordination with concrete.
  - 2. Section 04 20 00 - UNIT MASONRY for coordination with masonry construction.
  - 3. Section 07 21 00 - THERMAL INSULATION for building insulation.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions.
- B. Schedule: Submit a list of locations where structural thermal breaks are to be used, and the specific product and thickness to be used at each location.
- C. Shop Drawings: Submit shop drawings showing details of construction, and relationship of structural thermal break material with adjacent construction including fastening and/or anchorage connection details, thermal break material size and thickness.
- D. Thermal Design: Wall assembly or interface detail shall meet the ASHRAE 90.1 requirements for continuous insulation and shall not have structural connections (beams, support framing, sub girts, clips) which create thermal bridging. Effective U values of wall, roof and foundation assemblies shall meet or exceed the design requirements per code. Effective U value calculation or modeling shall be performed in accordance with ASHRAE guidelines.

1.4 QUALITY ASSURANCE

- A. Manufacturer: Minimum of 5 years' experience producing similar products.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Storage and Handling: Comply with manufacturer's recommendations for storage and handling. Protect from weather damage.

1.6 WARRANTY

- A. Warranty: Provide manufacturer's standard limited warranty against defects in manufacturing.

## **PART 2 - PRODUCTS**

### **2.1 STRUCTURAL THERMAL BREAK**

- A. High density, closed cell rigid polyurethane foam.
  - 1. Minimum Compressive Strength; 210 psi
  - 2. Minimum Compressive Modulus; 6155 psi
  - 3. Minimum Thermal Resistance (R value) per inch; 3.1
  - 4. Thickness; As indicated on the Drawings
  - 5. Manufacturers: Subject to compliance with requirements, provide one of the following:
    - a. Armatherm 500-080
    - b. Fabreeka TIM RF 640

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates for compliance with requirements for installation. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Install thermal breaks in accordance with manufacturer's instructions and approved submittals and the following:
  - 1. Install in proper relationship with adjacent materials.
  - 2. Protect from damage until acceptance.

**END OF SECTION**

SECTION 07 22 00  
ROOF AND DECK INSULATION

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Cover Board
- B. Rigid Board Insulation
- C. Fasteners and Plates
- D. Foam Adhesive
- E. Vapor Barrier
- F. Deck Sheathing

1.2 REFERENCES

- A. ASTM C165 Test Method for Measuring Compressive Properties of Thermal Insulation
- B. ASTM C208 Specification for Insulating Board (Cellulosic Fiber), Structural and Decorative
- C. ASTM C209 Methods of Testing Insulating Board (Cellulosic Fiber), Structural and Decorative
- D. ASTM C272 Test Method for Water Absorption of Core Materials for Structural Sandwich Constructions
- E. ASTM C473 Test Methods for Physical Testing of Gypsum Board Products and Gypsum Lath
- F. ASTM C518 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
- G. ASTM C578-971a Specification for Preformed, Cellular Polystyrene Thermal Insulation
- H. ASTM C728 Specification for Perlite Thermal Insulation Board
- I. ASTM C1177 Specification for Glass Matt Gypsum Substrate for use as Sheathing
- J. ASTM C1289 Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
- K. ASTM D41 Specification for Asphalt Primer Used in Roofing and Waterproofing
- L. ASTM D1621 Test Method for Compressive Properties of Rigid Cellular Plastics
- M. ASTM D1622 Test Method for Apparent Density of Rigid Cellular Plastics
- N. ASTM D2126 Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging
- O. ASTM D4601 Specification for Asphalt Coated Glass Fiber Base Sheet Used in Roofing
- P. ASTM E96 Test Methods for Water Vapor Transmission of Materials
- Q. FM Factory Mutual Engineering Corporation -
- R. Data Sheet 1-28 Insulated Steel Deck

1.3 SYSTEM DESCRIPTION

- A. UL Class "A" Rating
  - 1. It is the intent of this specification to provide a roof system with a UL Class "A" Rating. The descriptions given below are general descriptions. The insulation, recovery board, and other components shall be as required by the membrane manufacturer to obtain a UL Class "A" Rating.



B. Roof Drains

1. Provide tapered insulation sump at all roof drains. Tapered insulation sump shall start with a thickness of two and one-half inch (2.5") at the drain bowl to the specified thickness two feet (2'-0") from the centerline of the drain. Insulation shall be secured as specified below.

C. The work of this project is identified as follows:

1. Roof Level 1A - Install one (1) layer of peel and stick vapor barrier adhered in vapor barrier primer to the concrete deck. Insulation shall consist of polyisocyanurate insulation, adhered in a layer of foam adhesive to the vapor barrier at a rate sufficient to meet the requirements of FM 1-90. Insulation joints shall be staggered a minimum of 1 ft.-0 in. in all layers and directions. Install tapered polyisocyanurate crickets/saddles in a layer of foam adhesive as noted on Roof Plan directly under the cover board. Installation shall then consist of .25 inch (1/4") Cover board, adhered in a layer of foam adhesive.

1.4 SUBMITTALS

A. Submit under provisions of Section 01 3000 - Administrative Requirements.

B. Manufacturer's Product Data:

1. Most recent copy of manufacturer's literature applicable to products and specifications to be used, including material characteristics, test data, installation recommendations, material safety data sheets (MSDS).

C. Manufacturer's Installation Instructions:

1. Most recent copy of manufacturer's installation instructions for applications detailing products and specifications to be used.

D. Shop Drawings

1. Submit manufacturer's shop drawings for insulation system. Shop drawings shall show board-by-board layout pattern of the insulation system and shall comply with the drainage pattern as indicated on the plans.
  - a. The responsibility of providing shop drawings for the insulation system lies solely with the manufacturer of the insulation system. Shop drawings by others will not be accepted.
  - b. Shop drawings shall include: Outline of roof, location of drains, scuppers, or gutters, complete board layout of insulation components, thicknesses, and the average "R" value for the completed insulation system.
  - c. The roofing contractor shall verify all roof dimensions and drain locations and confirm same with the manufacturer prior for fabrication of tapered insulation.
2. Submit layout pattern for mechanical fasteners for the top layer of insulation that is fastened.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store all insulation materials in a manner to protect them from the wind, sun, and moisture damage prior to and during installation. Any insulation that has been exposed to any moisture shall be removed from the project site.
- B. Keep materials enclosed in a watertight, yet ventilated enclosure (i.e., tarpaulins).
- C. Store materials off of the ground. Any warped or broken insulation boards shall be removed from the site.

- D. Insulation packages shall be labeled to include manufacturer, material name, and production date.

## 1.6 TESTING

- A. Contractor shall have the manufacturer or an independent party acceptable to the manufacturer and Engineer/Architect conduct pullout-resistance test on gypsum and cementitious wood fiber decks to receive mechanically fastened insulation as specified herein.
- B. Pullout tests shall be conducted in accordance with the requirements of the membrane manufacturer, insulation manufacturer, and fastener manufacturer.
- C. The party conducting the pullout tests shall generate a report outlining the results of the tests. The reports shall be provided to the manufacturer, contractor, and Engineer/Architect.
- D. The party conducting the pullout tests shall notify Engineer/Architect in writing of any test that does not meet the manufacturer's requirements.

## PART 2 PRODUCTS

### 2.1 APPROVED EQUIVALENT

- A. Contractor must submit any product not specified a minimum five days before the bid date to Engineer/Architect in order for product to be considered for approval. The Engineer/Architect will notify Contractor, in writing, of decision to accept or reject request.

### 2.2 INSULATION MATERIALS

- A. Polyisocyanurate Foam Flat & Tapered Insulation
  - 1. Closed-cell, polyisocyanurate foam core with factory-laminated facers conforming to ASTM specification C 1289-95, Type II.
  - 2. Acceptable Manufacturers
    - a. Firestone ISO 95
    - b. Versico VersiCore Polyiso
    - c. Approved Equivalent
  - 3. Insulation board shall meet the following requirements:
    - a. UL listed under Roof Systems
  - 4. Physical Properties
    - a. Dimensional Stability: 2% maximum per ASTM D2126.
    - b. Compressive Strength: 20 psi minimum per ASTM C 165-95 or ASTM D1621.
    - c. Water Absorption: 1% maximum per ASTM C209.
    - d. Vapor Permeability: 1 perm maximum per ASTM E96.
    - e. Foam Core Density: 2.0 pcf minimum per ASTM D1622.
    - f. R-Factor HR: (sq. ft. per degree Fahrenheit per BTU) per inch thickness: 5.9 minimum per ASTM C5185.6
    - g. R-Value: 30 min continuous insulation.

h. Sheet Size:

- 1) 4 ft x 4 ft for applications where one or more layers of insulation is adhered.
- 2) Limit individual board thickness to 2" to 3" maximum. (Use multiple layers of boards with staggered joints as required to achieve overall insulation thickness). All roof systems require a minimum of 2 layers of insulation (minimum 4 inches total thickness).

2.3 COVER BOARD

A. Attachment with Adhesive

B. Thickness: 1/4" minimum

C. Manufacturers:

1. "DensDeck Prime" by Georgia Pacific.
2. "Securock" Gypsum Fiber Roof Board by USG,
3. Approved equivalent.

2.4 MECHANICAL FASTENERS FOR INSULATION MATERIALS

A. Mechanical Fasteners and Plates for Metal Deck (22-gauge)

1. Acceptable Manufacturers:

- a. Construction Fasteners
- b. ITW Buildex
- c. The Tru-Fast Corporation
- d. The Rawlplug Company, Inc.
- e. Olympic Fasteners
- f. Approved Equivalent

2. Requirements

- a. Plates shall be three inches in diameter minimum and composed of galvanized steel.
- b. Fastener and plates shall meet requirements of FM Standard 4470, passing the SRIU Corrosion Test Procedures - Kesternich DIN-50018 with 15% red rust allowable.
- c. Fastener and plate shall be approved within applicable FM tested roof system.

B. Wood Components

1. Use Factory Mutual approved fasteners and fastening pattern to install wood blocking and nailers.

2.5 ADHESIVE FOAM

A. Adhered Insulation.

1. Adhesive shall be "OlyBond 500" by Elastomeric Roofing Systems, Inc., 50 Medina St., Loretto, MN, 55357. Telephone number 612-479-6690 or 800-403-7747.
2. 'Millennium Weather-Tite One Step Foamable Adhesive', Millennium Adhesive Products, Inc., 16855 Park Circle Drive, Chagrin Falls, Ohio 44023, Telephone Number 440-708-1212 or 888-564-9733, Fax 440-708-1211.

3. Firestone 'I.S.O. Twin Pack™' Insulation Adhesive by Firestone, 200 4th Ave. South, Nashville, TN 37201. Telephone Number Sales 800-428-4442, Technical 800-428-4511.
4. Flexible Dash Dual Tank Adhesive by Versico Roofing Systems, PO Box 1289, Carlisle, PA 17013. Telephone Number 800-479-6832.
5. Approved equivalent.

## 2.6 VAPOR BARRIER

### A. Mechanically Fastened Insulation

1. Vap Air Seal - 725TR Air and Vapor Barrier by Versico Roofing Systems.
  - a. Vapor Barrier manufacturer's primer
2. V-Force Vapor Barrier Membrane by Firestone Building Products
  - a. V-Force solvent based primer
3. Approved equivalent
  - a. Vapor Barrier manufacturer's primer.

## PART 3 EXECUTION

### 3.1 INSPECTION OF SURFACES

- A. Examine surfaces for adequate anchorage, foreign materials, moisture and other conditions which would adversely affect the roofing application and performance.
- B. The roofing contractor shall be responsible for preparing an adequate substrate to receive insulation.

### 3.2 INSTALLATION

#### A. General

1. All membrane and accessories shall be field welded and fabricated. Factory custom or prefabricated roofing systems are not allowed.
2. Ponding of water in any spot on the roof is unacceptable. Ponding shall be defined as any water that remains on a roof surface longer than 48 hours after the termination of the most recent rain event. All incidents of ponding shall be repaired until ponding is eliminated.

#### B. Vapor Barrier

1. Apply primer to deck surfaces and vertical substrates at a rate that is required by manufacturer.
2. Apply one (1) layer of vapor barrier as required by manufacturer.

#### C. Roof Insulation (General Requirements)

1. Insulation shall be laid in parallel courses with all joints staggered between courses.
2. Insulation shall be neatly fitted to all roof penetrations, projections and nailers with no gaps greater than 1/4-inch.
3. Tapered insulation sump shall be installed around roof drains and scuppers with downspouts. Tapered insulation sump shall start with a thickness of two and one-half inch (2.5") at the drain bowl to the specified thickness and distance from the centerline of the drain. Install tapered insulation sump in such a way to provide proper slope for runoff. Shape insulation with tool as required to provide a smooth surface.

- a. Under no circumstances will the membrane be left unsupported in an area greater than one-fourth inch (1/4"). Install recovery board over tapered insulation sump as required.
  4. When more than one layer of insulation is used, joints shall be staggered a minimum of 1ft.-0 in. apart where possible with relation to the layer beneath, and each layer shall be fully attached to the roof deck in accordance with these specifications.
  5. No more insulation shall be placed on the surface to receive roof membrane than can be covered with roofing membrane before the end of the day's work or before the onset of inclement weather.
  6. Discard all damaged or broken insulation boards. Insulation shall be dry when installed and protected from weather during application. All materials which become wet or warped shall be removed from the site and replaced with new dry materials.
  7. Provide insulation saddles at all curbs.
  8. The practice of "glazing-in" insulation as a temporary roof is considered phased construction, and will not be accepted.
  9. Cut tapered insulation for final adjustments where insulation is thinnest. Dress down mismatches in surface greater than one-eighth inch (1/8").
- D. Attachment with Adhesive
1. Attachment of insulation to substrate with adhesive shall be as recommended by the insulation manufacturer. Size of insulation board shall be 4' x 4' maximum. (4x8 sheets, cut down to 4x4, will not be allowed.)
  2. Embed roof insulation boards in adhesive. Lay in parallel courses. Butt each panel to adjoining panels. Carefully walk in each piece of insulation and continue to walk in and test for adhesion until adhesive has set and provided complete securement. Boards which can be lifted up without breaking are inadequately adhered and shall be reset in fresh moppings.
  3. If insulation facer is damaged in application and/or under foot or cart traffic, refer to insulation manufacturer's recommendations for patching facer, or replace damaged insulation boards with new.
  4. Required adhesion will not be achieved unless the insulation contacts the adhesive before it sets. Contact is best achieved by passing the loaded insulation cart over the row of insulation as it is being laid, taking insulation from the cart. Sufficient "walking in" will also result from the installer stepping on each square foot of surface before the adhesive sets, but the common practice of shoving each board in and kicking it in one place will not achieve acceptable adhesion. Adhesion will not occur at a later date but must be achieved as laid.
  5. Cutting and fitting and trying around irregularities or protrusions shall be done before adhering insulation to the substrate.

### 3.3 ROOF INSPECTION

- A. All membrane roofs shall be inspected by the roofing manufacturer's factory representative. Owner's representative shall be present during the inspection. Contractor shall notify the Owner a minimum of 48 hours prior to this inspection.

### 3.4 CLEANING OF ROOFS

- A. All stains (including rust stains), fasteners, dirt, debris, etc. shall be cleaned and removed by the roofing installer upon completion of installation. Roof membrane shall be cleaned again by the roofing installer, or by the General Contractor in accordance with the manufacturer's recommendations just prior to substantial completion to remove subsequent stains (including rust stains), fasteners, dirt, debris, etc.

**END OF SECTION**

SECTION 07 26 00  
VAPOR RETARDERS

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Vapor retarders.

1.2 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Vapor retarder under concrete slabs on grade.

1.3 DEFINITIONS

- A. Vapor Retarder: Airtight barrier made of material that is relatively water vapor impermeable, to degree specified, with seams and joints sealed to adjacent surfaces.
- B. Vapor Retarder Class: A measure of a material or assembly's ability to limit the amount of moisture that passes through that material or assembly. Vapor retarder class is defined using Procedure A, Desiccant Method at 73 degrees F (23 degrees C) and 50 percent Relative Humidity (RH), in accordance with ASTM E96/E96M and ICC (IBC)-2018, as follows:
  - 1. Class I: 0.1 perm or less.
  - 2. Class II: Greater than 0.1 perm to 1.0 perm.
  - 3. Class III: Greater than 1.0 perm to 10 perms.

1.4 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2021.
- C. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022a.
- D. ICC (IBC)-2018 - International Building Code; 2018.

1.5 SUBMITTALS

- A. Product Data: Provide data on material characteristics, performance criteria, and limitations.
- B. Manufacturer's Installation Instructions: Indicate preparation, installation methods, and storage and handling criteria.

1.6 FIELD CONDITIONS

- A. Maintain temperature and humidity recommended by materials manufacturers before, during, and after installation.

**PART 2 PRODUCTS**

2.1 VAPOR RETARDERS

- A. Underslab Vapor Retarders: See Section 03 30 00.

- B. Vapor Retarder Coating: Liquid applied, resilient, ultra-violet (UV) light resistant coating; associated joint treatment.
1. Dry Film Thickness (DFT): As required by manufacturer to achieve performance requirements.
  2. Water Vapor Permeance: 1.0 perm (57 ng/(Pa s sq m)), maximum, when tested in accordance with ASTM E96/E96M.
  3. VOC Content: Less than 6.68 oz/gal (50 g/L), when tested in accordance with 40 CFR 59, Subpart D - EPA Method 24.
  4. Suitable for use on concrete, masonry, plywood, and gypsum sheathing.
  5. Joint Preparation Treatment: Provide coating manufacturer's recommended method, either tape or reinforcing mesh saturated with coating material.
  6. Joint Filler: As recommended by coating manufacturer and suitable to the substrate.
  7. Products:
    - a. Tremco Inc.; ExoAir 130: [www.tremcosealants.com/#sle](http://www.tremcosealants.com/#sle).
    - b. Henry Company; Air-Bloc 16MR: [www.henry.com/#sle](http://www.henry.com/#sle).
    - c. Master Builders Solutions; MasterSeal AWB 660 I: [www.master-builders-solutions.com/en-us/#sle](http://www.master-builders-solutions.com/en-us/#sle).
    - d. Substitutions: See Section 01 60 00 - Product Requirements.

## 2.2 ACCESSORIES

- A. Sealants, Tapes, and Accessories for Sealing Vapor Retarder and Adjacent Substrates: As indicated, complying with vapor retarder manufacturer's installation instructions.
- B. Flexible Flashing: Self-adhesive sheet flashing complying with ASTM D1970/D1970M; slip resistance requirement waived if not installed on roof. Complying with vapor retarder manufacturer's installation instructions.
- C. Liquid Flashing: One part, fast curing, nonsag, elastomeric, gun grade, trowelable. Complying with vapor retarder manufacturer's installation instructions.
- D. Thinners and Cleaners: As recommended by vapor retarder manufacturer.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that surfaces and conditions comply with requirements of this section.

### 3.2 PREPARATION

- A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.

### 3.3 INSTALLATION

- A. Install materials in accordance with manufacturer's installation instructions.
- B. Vapor Retarders: Install continuous airtight barrier over surfaces indicated, with sealed seams and sealed joints to adjacent surfaces.
- C. Apply sealants and adhesives within recommended temperature range in accordance with manufacturer's installation instructions.



D. Vapor Retarder Coatings:

1. Prepare substrate in accordance with coating manufacturer's installation instructions; treat joints in substrate and between dissimilar materials as indicated.
2. Apply flashing to seal with adjacent construction and to bridge joints in coating substrate.

E. Openings and Penetrations in Exterior Vapor Retarders:

1. Install flashing over sills, covering entire sill framing member, and extend at least 5 inches (127 mm) onto vapor retarder and at least 6 inches (152 mm) up jambs; mechanically fasten stretched edges.
2. At openings with nonflanged frames, seal vapor retarder to each side of framing at opening using flashing at least 9 inches (230 mm) wide, and covering entire depth of framing.
3. At head of openings, install flashing under vapor retarder extending at least 2 inches (50 mm) beyond face of jambs; seal vapor retarder to flashing.
4. At interior face of openings, seal gaps between window/door frame and rough framing using appropriate joint sealant over backer rod.
5. Service and Other Penetrations: Form flashing around penetrating items and seal to surface of vapor retarder.

3.4 PROTECTION

- A. Do not leave materials exposed to weather longer than recommended by manufacturer.

**END OF SECTION**

SECTION 07 62 00  
SHEET METAL FLASHING AND TRIM

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Provide sheet metal flashing systems, complete, in-place as detailed on the drawings and as specified herein. This section includes sheet metal flashing and trim in the following categories:
  - 1. Roof Drainage Systems
  - 2. Exposed Trim, Gravel Stops and Fascia
  - 3. Copings
  - 4. Metal Counterflashings

1.2 REFERENCES

- A. ASTM A446-91: Specification for Steel Sheet, Zinc Coated (Galvanized) by Hot Dip Process.
- B. ASTM B209-92: Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- C. FM (Factory Mutual): Loss Prevention Data Sheet 1 - 49.
- D. FS QQ-L-201: Specification for Lead Sheet.
- E. SMACNA: Architectural Sheet Metal Manual.

1.3 SYSTEM DESCRIPTION

- A. Pre-finished galvanized steel at all locations noted in drawings. Color shall be chosen by the Architect.

1.4 SUBMITTALS

- A. Manufacturer's Product Data
  - 1. Metal material characteristics and installation recommendations.
  - 2. Color chart for pre-finished metal. For acceptable manufacturers other than Petersen Aluminum Corporation, submit color chart prior to material ordering and/or fabrication so that equivalent colors to those specified can be approved.
- B. Shop Drawings
  - 1. For manufactured and shop-fabricated copings and all other sheet metal fabrications.
  - 2. Show profile, joint details, corner details, and types and locations of fasteners.
  - 3. Indicate type, gauge and finish of metal.

1.5 QUALITY ASSURANCE

- A. Reference standards
  - 1. Comply with details and recommendations of the latest edition of the Architectural Sheet Metal Manual for workmanship, methods of joining, anchorage, provisions for expansion, etc.
  - 2. Factory Mutual Loss Prevention Data Sheet 1-49, Windstorm Resistance, 1-90 minimum.

## 1.6 WARRANTY

- A. Pre-finished metal material shall require a written **20-year non-prorated warranty** covering fade, chalking and film integrity. The material shall not show a color change greater than 5 NBS color units per ASTM D2244, or chalking excess of 8 units per ASTM D659. If either occurs, material shall be replaced per warranty at no cost to the Owner.
- B. The Contractor shall provide the Owner with a notarized written warranty assuring all sheet metal work, including caulking and fasteners, to be water-tight and secure for a period of **five (5) years** from the date of final acceptance of the building. Warranty shall include all materials and workmanship required to repair any leaks that develop, and make good any damage to other work or equipment caused by such leaks or the repairs thereof. Refer to the sample warranty at the end of the roof membrane section.

## PART 2 PRODUCTS

### 2.1 APPROVED EQUIVALENT

- A. Contractor must submit to the architect/engineer a minimum of five days before the bid date any product not specified in order for product to be considered for approval. The architect/engineer will notify contractor, in writing, of decision to accept or reject request.

### 2.2 METAL FLASHING

- A. Pre-finished Galvanized Steel
  - 1. Acceptable Manufacturers.
    - a. ColorKlad as manufactured by Vincent Metals.
    - b. Pac-Clad as manufactured by Petersen Aluminum Corporation.
    - c. UnaClad as manufactured by Copper Sales, Inc.
    - d. Roofing membrane manufacturer supplied approved equivalent.
    - e. Approved equivalent.
  - 2. Materials used to fabricate items including, but not limited to, scuppers, exposed trim, copings, counterflashings, and curb flashings shall have the following characteristics:
    - a. Material shall be 24 gauge (minimum) hot-dipped galvanized steel (AISI G90), primed and finished one side with 70% Kynar 500 resin based fluoropolymer coating 1.0 ± 0.1 mil dry film thickness.
    - b. A wash coat of 0.3 - 0.4 mil dry film thickness shall be applied to the reverse side.
    - c. The pre-painted finished side shall be coated with a factory installed strippable film for protection of the finished surface during shipping, fabrication, and installation. Plastic film must be removed immediately after installation.
    - d. Colors: Match existing.
    - e. Thickness shall be 24 gauge (minimum) and shall increase in thickness as recommended by metal manufacturer as face height increases.
    - f. Prefinished metal covers and trim to hide membrane visible from ground level (i.e. at roof scuppers, etc.).

## 2.3 FASTENERS

- A. Stainless steel screws with EPDM washers of appropriate length and gauge, as recommended by metal manufacturer.
- B. Material fasteners shall match that of metal which it secures (i.e. for aluminum - aluminum fasteners, etc.)
- C. Fastening shall conform to Factory Mutual I-90 requirements or as stated on section details, whichever is more stringent.

## 2.4 COPINGS, JOINT COVERS, AND COUNTERFLASHINGS

- A. Material as noted in details.
- B. Accessories: Joint covers, corners, supports, strip flashing at joinings, fastening, and other accessories shall be included.

## 2.5 TERMINATION BARS

- A. Shall be aluminum unless otherwise recommended by membrane manufacturers.
- B. Material shall be 0.125" x 1" (minimum) aluminum conforming to ASTM B221, mill finish. Bar shall have caulk cup as required.

## 2.6 FABRICATION, GENERAL

- A. Sheet Metal Fabrication Standard:
  - 1. Fabricate sheet metal flashing and trim to comply with recommendations of the latest edition of the Architectural Sheet Metal Manual that apply to the design, dimensions, metal, and other characteristics of the item indicated.
- B. Shop Fabrication
  - 1. Comply with details shown to fabricate sheet metal flashing and trim that fit substrates and result in waterproof and weather-resistant performance once installed. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
  - 2. Form exposed sheet metal work that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems.
- C. Seams:
  - 1. Space joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Provide joint details in compliance with the recommendations of the latest edition of the Architectural Sheet Metal Manual for the thickness, girth, and type of metal.
- D. Dissimilar Metals
  - 1. Separate flashings from non-compatible metal or corrosive substrates by coating concealed surfaces at locations of contact with asphalt mastic or other permanent separation as recommended by manufacturer.
  - 2. Install continuous butyl tape between the edge of the roof membrane and the face of the wall behind the continuous cleats.
- E. Attachment:
  - 1. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of sheet metal exposed to public view.
  - 2. Cleats (Hook Strips) shall be minimum 22 gauge, galvanized steel, continuous.

3. Fabricate cleats and attachment devices from same material as sheet metal component being anchored or from compatible, noncorrosive metal recommended by sheet metal manufacturer.
4. Size cleats as recommended by the latest edition of the Architectural Sheet Metal Manual or sheet metal manufacturer for application but never less than thickness of metal being secured.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates and conditions under which sheet metal flashing and trim are to be installed and verify that Work may properly commence. Do not proceed with installation until unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

#### **A. General:**

1. Unless otherwise indicated, install sheet metal flashing and trim to comply with performance requirements, manufacturer's installation instructions, and the recommendations of the latest edition of the Architectural Sheet Metal Manual. Anchor units of Work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated. Install Work with laps, joints, and seams that will be permanently watertight and weatherproof.
2. Install exposed sheet metal Work that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance. Verify shapes and dimensions of surface to be covered before fabricating sheet metal.
3. Roof-Edge Flashing: Secure metal flashing at roof edges according to FM Loss Prevention Data Sheet 1-49 for specified wind zone.
4. Expansion Provisions: Provide for thermal expansion of exposed sheet metal Work. Space movement joints at maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions in Work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, not less than one inch deep, filled with mastic sealant (concealed within joints).
5. Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards. Fill joint with sealant.
6. Seams: Fabricate non-moving seams in sheet metal with flat-lock seams. Tin edges to be seamed, form seams, and solder.
7. Separations: Separate metal from non-compatible metal or corrosive substrates by coating concealed surfaces, at locations of contact, with asphalt mastic or other permanent separation as recommended by manufacturer.
  - a. Underlayment: Where installing stainless steel or aluminum directly on cementitious or wood substrates, install a slip sheet of red-rosin paper and a course of polyethylene underlayment.
  - b. Bed flanges of Work in a thick coat of roofing cement where required for waterproof performance.

8. Counterflashings: Coordinate installation of counterflashings with installation of assemblies to be protected by counterflashing. Install counterflashings in reglets or receivers. Secure in a waterproof manner by means of snap-in installation and sealant, lead wedges and sealant, interlocking folded seam, or blind rivets and sealant. Lap counterflashing joints a minimum of 2 inches and bed with sealant.
9. Roof-Drainage System: Install drainage items fabricated from sheet metal, with straps, adhesives, and anchors recommended by SMACNA's Manual or the item manufacturer, to drain roof in the most efficient manner. Coordinate roof-drain flashing installation with roof-drainage system installation. Coordinate flashing and sheet metal item for steep-sloped roofs with roofing installation.
10. Equipment Support Flashing: Coordinate equipment support flashing installation with roofing and equipment installation. Weld or seal flashing to equipment support member.
11. Roof-Penetration Flashing: Coordinate roof-penetration flashing installation with roofing and installation of items penetrating roof. Install flashing as follows:
  - a. Seal and clamp flashing to pipes penetrating roof, other than lead flashing on vent piping.

### 3.3 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces, removing substances that might cause corrosion of metal or deterioration of finishes.
- B. Provide final protection and maintain conditions that ensure sheet metal flashing and trim Work during construction is without damage or deterioration other than natural weathering at the time of Substantial Completion.

**END OF SECTION**

SECTION 07 75 37  
PVC MEMBRANE ROOFING - FULLY ADHERED

**PART 1 GENERAL**

1.1 WORK INCLUDES

- A. PVC sheet roofing attached with adhesive.
- B. Membrane flashings.
- C. Other accessories as required.
- D. Membrane manufacturer's warranty.

1.2 REFERENCES

- A. ASTM D570 - Test Method for Water Absorption of Plastics
- B. ASTM D638 - Test Methods for Tensile Properties of Plastics
- C. ASTM D1004 - Test Method for Initial Tear Resistance of Plastic Film and Sheeting
- D. ASTM D1204 - Test Method for Linear Dimensional Changes of Non-Rigid Thermoplastic Sheeting or Film at Elevated Temperature
- E. ASTM D2136 - Test Method for Coated Fabrics - Low Temperature Bend Test
- F. ASTM D2565 - Practice for Operating Xenon Arc-Type Light Exposure Apparatus With and Without Water for Exposure of Plastics
- G. ASTM D3045 - Practice for Heat Aging of Plastics Without Load
- H. ASTM D4434 - Specification for Poly(Vinyl Chloride) Sheet Roofing
- I. ANSI/UL 790 - Tests for Fire Resistance of Roof Covering Materials
- J. FM 1-49 - Factory Mutual Loss Prevention Data-Perimeter Flashing
- K. FM - 1-60 - Design Standards for wind uplife (Fully adhered attached).
- L. NRCA - NRCA Roofing and Waterproofing Manual, Fifth Edition.
- M. Membranes manufacturer's current published specifications, application instructions, and technical bulletins.

1.3 SYSTEM DESCRIPTION

- A. Roof Level 1A - Fully-adhered 60 mil thick PVC (polyvinyl chloride) membrane meeting the requirements of Underwriters Laboratories Class A fire resistance rating for the installed slope.

1.4 SUBMITTALS

- A. Submit under the general provisions of these specifications.
- B. All submittals shall be subject to the Owner's review and approval.
- C. Manufacturer's Product Data:
  - 1. Most recent copy of manufacturer's literature applicable to products and specifications to be used, including material characteristics, test data, installation recommendations, material safety data sheet (MSDS), and complete flashing details of system. MSDS sheets shall be submitted directly to the Owner.
  - 2. Specimen copy of manufacturer's warranty.

- D. Manufacturer's Installation Instructions:
- E. Most recent copy of manufacturer's installation instructions for applicators detailing products and specifications to be used including procedures for installation of membrane and flashing.
- F. Manufacturer's Certificates:
  - 1. Copy of completed contractor's application form for manufacturer's warranty to be submitted to the Architect/Engineer at the same time as original is submitted to the membrane manufacturer.
  - 2. Copy of the contractor-submitted manufacturer's warranty form approved by the manufacturer. Note: The Contractor will not be permitted to start work until the approved warranty form is submitted to the Architect/Engineer.
- G. Shop Drawings:
  - 1. Roof Plan and Details: By submittal of a bid for this project, the Contractor certifies that the project plans and specifications have been reviewed, and that the proposed roof system will be installed in accordance with these plans and specifications. If, after award of contract and upon review of existing field conditions, the Contractor wishes to modify the roof plans and/or details, the proposed change shall be submitted as a shop drawing for review by the Architect/Engineer.
  - 2. Roof Insulation: Reference Section 07 2220 - Roof and Deck Insulation for requirements.
- H. Manufacturer's Field Services and Reports: Reference Division 01 for Quality Control for requirements.

#### 1.5 QUALITY ASSURANCE

- A. Applicator shall be certified by manufacturer to install specified products.
- B. The entire installation of roofing, insulation, flashing and sheet metal work shall be of the quality required for acceptance by the membrane manufacturer to obtain the warranty specified in this section.
- C. Comply with the requirements of the regulatory agencies as specified herein.
- D. As an approved applicator, all items required by the membrane manufacturer in the installation of the manufacturer's system will be included in the work.
- E. The roofing contractor shall assure that all roofing materials (i.e., membrane, insulation, fasteners, asphalt, adhesives, sealants, etc.) are compatible with each other and the substrates which they will be in contact with.

#### 1.6 QUALIFICATIONS

- A. Qualifications of Manufacturer:
  - 1. Manufacturer must have existing installations similar to the specified system, being at least **15 years** old and installed in a climate similar to that of the proposed installation. Upon request, Manufacturer shall provide documentation supporting such claims.
- B. Qualifications of Contractor:
  - 1. All contractors must be certified by the membrane manufacturer as an approved applicator of the products specified within these contract documents.
  - 2. The contractor will demonstrate **10 years** of experience as the "bidding entity." A bidder is defined as the "bidding entity," i.e., the corporation, partnership or other entity in whose name a bid is submitted. Experience and qualifications required of "the bidder" will refer, first, to the bidding entity rather than the experience, either individual or aggregate, of the individuals who make up the company. The experience of key personnel will also be considered in the process of evaluating the bidding entity.



3. The bidding entity shall submit a list of **five (minimum)** projects of comparable size and complexity, utilizing like / similar roof systems. Include contact names and numbers for the General Contractor and the Owner for each project listed.

#### 1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver and store materials under provisions of Division 01.
- B. Deliver materials in sufficient quantity to allow continuity of work.
- C. Coordinate delivery of materials with Owner so that minimal interruption of Owner's operations occurs.
- D. Materials shall be stored in their original, tightly sealed containers or unopened packages, and shall be clearly labeled with the manufacturer's brand name and such identifying reference numbers as are appropriate. Deliver materials to job site on pallets. Do not stack pallets.
- E. Materials shall be stored in a neat, safe manner so as not to exceed allowable live load of the storage area. Contractor shall not load pallets of material onto the roof deck without approval from the Architect/Engineer prior to loading. Disperse materials on roof deck to avoid concentrated loading.
- F. Store materials in dry, protected areas in an upright position. Control temperature of storage areas in accordance with manufacturer's instructions. Protect materials from freezing.
- G. Follow manufacturer's guidelines for required temperatures of material prior to application.
- H. Any materials damaged in handling or storage are not to be used.
- I. The Contractor shall assume full responsibility for the protection and safekeeping of materials stored on Owner's premises.
- J. Store roll goods on ends only. Discard rolls which have been flattened, creased or otherwise damaged.
- K. Remove wet material from project site.
- L. Comply with fire and safety regulations.
- M. Splice cleaner and bonding adhesives are extremely flammable. Do not use near fire or flame or in unventilated areas. Dispense from UL approved containers and consult material safety data sheets for specific information.
- N. Do not allow the PVC membrane to come into direct contact with steam or steam source.
- O. Installation may continue in cold weather provided adhesives and sealants are stored at room temperature prior to application and used within a 4-hour period after being brought to the roof, if approved by the manufacturer.

#### 1.8 JOB CONDITIONS

- A. Apply roofing in dry weather.
- B. If the newly constructed roof or existing insulation becomes wet due to rainstorms, faulty water cut-offs, or other reasons, the Contractor shall remove and dispose of all wet materials, dry the affected roof area, and reconstruct the roof in accordance with these specifications at no cost to the Owner.
- C. Coal tar base, oil base or plastic roof cements are not to be used in direct contact with steam or steam source.
- D. All bonding, splicing and sealing surfaces must be free of dirt, moisture and any other contaminants.

- E. The roof surface shall be free of ponded water, ice, snow, or algae prior to installing the new roof system.
- F. Ensure roof deck is structurally sound to support construction traffic. Notify Owner or Architect/Engineer immediately of any conditions that are not structurally sound.

#### 1.9 SAFETY

- A. All application, material handling and associated equipment shall conform to and be operated in conformance with OSHA safety requirements.
- B. Comply with federal, state, local and Owner fire and safety regulations.
- C. Advise Owner and Architect/Engineer whenever work is expected to be hazardous to Owner's operations or occupants.
- D. Maintain a crewman as a floor area guard whenever roof decking is being repaired or replaced.
- E. Maintain fire extinguisher within easy access whenever power tools, roofing kettles and torches are being used.

#### 1.10 WARRANTY

- A. Provide warranty and guarantee under provisions of the general provisions of these specifications.
- B. Provide to the Owner the membrane manufacturer's **twenty (20) year** no-dollar limit material and workmanship warranty effective from the date of final acceptance by the Owner.
- C. The Contractor shall provide to the Owner a notarized written warranty assuring that all roofing work including caulking, flashing, and sheet metal to be watertight for a period of **two (2) years** from the date of substantial completion. Warranty shall include all materials and workmanship required to repair any leaks that develop as a result of the work. Refer to sample provided at the end of this Section.

### PART 2 PRODUCTS

#### 2.1 RELATED MATERIALS BY MEMBRANE MANUFACTURER

- A. PVC reinforced sheet (ASTM D4434), Approved Manufacturers & Products
  - 1. Sarnafil Roofing System by Sarnafil, Inc.:
    - a. Fully Adhered: G410 PVC.
  - 2. Fibertite Roofing System by Seaman Corporation:
    - a. Fully Adhered: FiberTite SM (with Elvaloy Kee polymer)
  - 3. Flex Roofing System by Flex International Corp.:
    - a. Fully Adhered: Flex MF/R 60 PVC.
- B. Substitutions: (subject to compliance with specifications) Submit Document 00 43 25 Supplement F – Proposed Substitution Form (Bidding Phase).
- C. Minimum Thickness:
  - 1. PVC: 60 mils +/- 3 mil.
- D. Exposed Face Color: White.
- E. All field membrane material shall have “factory” edges.
- F. Maximum Roll Width for fully adhered: Standard size recommended by the manufacturer.

## 2.2 ACCESSORIES

### A. Roof walkway pads

1. Thermoplastic heat welded, non-slip walkway pad compatible with roof membrane per manufacturer.
2. Color: Grey or Black
3. Thickness: 79 mil (2 mm) minimum
4. Location: As shown on drawings.

## PART 3 EXECUTION

### 3.1 PRE-INSTALLATION CONFERENCE

- A. Prior to the start of the roofing work a meeting will be held at the job site for the purpose of reviewing materials, methods, and procedures to facilitate proper and timely construction of the roof system. Reference Division 01 - Coordination and Meetings for requirements.

### 3.2 REFERENCE

- A. The current product specification guide published by the membrane manufacturer shall be considered part of this specification and shall be referred to for more specific application procedures regarding roofing insulation, membrane and base flashing. When a difference between this specification and the manufacturer's product specification guide is encountered, the provision which is most stringent shall govern.

### 3.3 INSPECTION OF SURFACES

- A. Examine surfaces for adequate anchorage, foreign materials, moisture, and other conditions which would adversely affect the roofing application and performance.
- B. The roofing contractor shall be responsible for preparing adequate surfaces to receive insulation, roofing and flashing.

### 3.4 APPLICATION - GENERAL

- A. Install in accordance with the accepted roofing manufacturer's written specifications and recommended details now on file in the Architect/Engineer's office.
- B. Protect building wall area with tarpaulins or other durable materials at staging and kettle areas.
- C. Roof surfaces shall be thoroughly dry before application of roofing.
- D. Inspection of the roofing shall be made by a responsible representative of the roofing manufacturer during application and after completion. Reference Division 01 for Quality Control requirements.
- E. Roofing insulation shall be dry when installed and shall be protected from the weather during installation. All materials which become wet shall be removed and replaced with new dry materials.
- F. Membrane shall be installed over membrane manufacturer approved insulation. Install recovery board as required by the membrane manufacturer although details on the plans may not show it.
- G. When application of roofing is begun, the total roofing system in that area shall be completed before the end of the day and before being wet by the elements.

- H. Install temporary water cut-offs at the completion of each day's work and remove upon resumption of the work. Any leaks and damage due to insufficient water cut-offs shall be repaired by the Contractor at no cost to the Owner.
- I. Precautions shall be taken to protect the membrane from puncture.
- J. If materials are stored on the roof, the materials will be protected from the existing roof.
- K. Special care will be taken to prevent distress on the building structure when handling materials for the project.

### 3.5 SEQUENCING/SCHEDULING

- A. Notify the Owner and Architect/Engineer 48 hours before the first day of construction.
- B. Install all base flashing and/or fascia system fasteners and metal work, at least throughout the anticipated working area, as soon as possible after any roofing application.

### 3.6 DECK PREPARATION

- A. The roof deck and existing roof construction must be structurally sound to provide support for the new roof system. Membrane manufacturer requires fastener pullout test to verify deck condition and fastener pullout values.

### 3.7 SUBSTRATE PREPARATION

- A. A proper substrate shall be provided to receive the membrane and fully adhered system.
- B. The roofing contractor shall inspect the substrate for defects such as excessive surface roughness, contaminated surfaces, structurally unsound substrates, etc., that will adversely affect the quality of work.
- C. The substrate shall be clean, smooth, dry, free from flaws, sharp edges, loose and foreign material, oil, and grease. Roofing shall not start until all defects have been corrected.

### 3.8 WOOD NAILERS

- A. Install continuous treated wood nailers at the perimeter of the entire roof and around roof projections and penetrations as specified on project drawings.
- B. Nailers shall be anchored to resist a minimum force of 175 pounds per lineal foot in any direction. Fastener spacing shall be a maximum of 3 feet on center. Fasteners shall be installed within 6 inches of each end. Spacing and fastener embedment shall conform to Factory Mutual Loss Prevention Data Sheet 1-49.
- C. Thickness shall be as required to match substrate or insulation height.
- D. Any existing woodwork that is to be reused shall be firmly anchored in place (shall resist a minimum force of 175 pounds per lineal foot in any direction) and free from rot. Only woodwork designated to be reused in detail drawings shall be left in place and all other woodwork shall be removed.

### 3.9 MEMBRANE INSTALLATION

- A. The surface of the insulation or substrate shall be inspected prior to installation of the roof membrane. The substrate shall be clean, dry and smooth with no excessive surface roughness, contaminated surfaces or unsound surfaces such as broken or delaminated insulation boards.

### 3.10 HOT-AIR WELDING OF LAP AREAS

#### A. General

1. Adjacent sheets shall be welded in accordance with membrane manufacturer's written instructions. All side and end lap joints shall be hot-air welded. Lap area shall be a minimum of 3 inches wide when machine welding, and a minimum of 4 inches wide when hand welding.
2. Welding equipment shall be provided by or approved by membrane manufacturer. All mechanics intending to use the equipment shall have successfully completed a course of construction provided by a membrane manufacturer representative prior to welding.
3. All surfaces to be welded shall be clean according to membrane manufacturer's instructions and dry. No adhesive shall be present within the lap of welding.

#### B. Hand Welding

1. Hand welded seams shall be completed in three stages. Equipment shall be allowed to warm up for at least one minute prior to start of welding.
2. The lap shall be tack welded every 3 feet to hold the material in place.
3. The back edge of the lap shall be welded with a thin, continuous weld to prevent loss of hot air during the final welding.
4. The hot-air nozzle shall be inserted into the lap, keeping the welding equipment at a 45 degree angle to the side lap. Once the proper welding temperature has been reached and the material starts to flow, the hand roller shall be applied at a tight angle to the welding gun and pressed lightly. For straight laps, the 1-1/2 inch wide nozzle shall be used. For corners and compound connections, the 3/4 inch wide nozzle shall be used.

#### C. Machine Welding

1. Machine welded seams may be achieved by the use of membrane manufacturer's various automatic welding equipment. When using this equipment, the manufacturer's instructions shall be followed and local codes for electric supply, grounding, and overcurrent protection observed. The automatic welding machines require 218 to 230 volts at 30 amps. The use of a portable generator is recommended.
2. When welding sheets adhered with membrane manufacturer 2121 adhesive, 15-inch wide metal tracks must be used over the deck sheet and under the machines welder to prevent wrinkles.

#### D. Quality Control of Welded Seams

1. All completed welded seams shall be checked after cooling for continuity using a rounded screwdriver or other suitable blunt object by the roofing contractor. Visible evidence that welding is proceeding acceptably is smoke during the welding operation, shiny membrane surfaces, and an uninterrupted flow of black material from the edge of completed joints. On-site evaluation of welded seams shall be made daily by the contractor at locations as directed by the owner's representative or membrane manufacturer's representative. Two-inch wide cross-sectional samples shall be taken three times a day minimum thorough completed seams. Correct welds display failure from shearing of the membrane prior to separation of the weld. Each test cut shall be patched by the contractor at no extra charge to the Owner.

### 3.11 MEMBRANE FLASHINGS

- A. All flashings shall be installed concurrently with the roof membrane as the job progresses. No temporary flashings shall be allowed without the prior written approval of the project manager and membrane manufacturer. Approval shall be for specific locations on specific dates. If any water is allowed to enter under the new roofing due to incomplete flashings, the affected area shall be removed and replaced at the contractor's expense. Flashings shall be adhered to compatible, dry, smooth and solvent-resistance surfaces.

### 3.12 SHEET METAL WORK

- A. Counterflashings, copings and other perimeter or penetration metal work shall be properly fastened and sealed by the roofing contractor or others, and it shall be their responsibility to maintain this work in a watertight condition. Care should be taken to assure the membrane is not in contact with sharp edges and is not unsupported in an area greater than 1/4-inch.

### 3.13 MEMBRANE CLEAN-UP

- A. Clean the roof membrane in locations where handprints, footprints, general traffic grime, industrial pollutants, and environmental dirt are present. Clean the membrane by using a non-abrasive scrub pad with a non-abrasive soap and water. Then rinse the area completely with clean water. In heavily soiled locations clean the membrane with the manufacturer's cleaner used to clean the seams, however; this cleaner shall be used sparingly.
  - 1. Scrub Pads
    - a. 3M - Doodlebug Pads
    - b. Carlisle Sanitary Maintenance Products - Scrub Pads 4072500
  - 2. Seam Cleaner
    - a. Sika Sarnafil – Seam Cleaner
    - b. Approved Equivalent

### 3.14 MANUFACTURER'S WARRANTY INSPECTIONS

- A. Inspections shall be in accordance with Division 01 for Quality Control.
- B. After the work has started, an inspection shall be made by a field technical representative of the membrane manufacturer. The representative shall review materials, methods, and procedure to facilitate proper and timely construction of the roofing system. Upon completion of the inspection the contractor shall submit to the Architect/Engineer a written report of the field technical representative's findings.
- C. Upon completion of the installation, an inspection shall be made by a field technical representative of the membrane manufacturer to ascertain that the roofing system has been installed according to the manufacturer's current published specifications. Upon completion of the inspection, the Contractor shall submit to the Architect/Engineer a written report of the field technical representative's findings.

**END OF SECTION**

SECTION 07 81 00  
APPLIED FIRE PROTECTION

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Patching of applied fire protection of interior structural steel not exposed to damage or moisture.

1.2 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- B. ASTM E736/E736M - Standard Test Method for Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members; 2019 (Reapproved 2023).
- C. ASTM E760/E760M - Standard Test Method for Effect of Impact on Bonding of Sprayed Fire-Resistive Material Applied to Structural Members; 1992 (Reapproved 2023).
- D. ASTM E859/E859M - Standard Test Method for Air Erosion of Sprayed Fire-Resistive Materials (SFRMs) Applied to Structural Members; 2023.
- E. ASTM E937/E937M - Standard Test Method for Corrosion of Steel by Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members; 1993 (Reapproved 2023).
- F. UL (FRD) - Fire Resistance Directory; Current Edition.

1.3 SUBMITTALS

- A. Product Data: Provide data indicating product characteristics.
- B. Field Quality Control Submittals: Submit field test report.

1.4 FIELD CONDITIONS

- A. Do not apply fireproofing when temperature of substrate material and surrounding air is below 40 degrees F (4 degrees C) or when temperature is predicted to be below said temperature for 24 hours after application.
- B. Provide temporary enclosure to prevent spray from contaminating air.

**PART 2 PRODUCTS**

2.1 APPLIED FIRE PROTECTION ASSEMBLIES

- A. Provide fire resistance ratings for following building elements as required by local building code:
  - 1. Primary structural frame, including columns, girders, and trusses, 1 hour.
  - 2. Bearing walls, interior, 2 hours.

2.2 MATERIALS

- A. Applied Fire Protection Material for Interior Applications, Exposed to View and Not to Damage : Manufacturer's standard factory mixed material, which when combined with water is capable of providing indicated fire resistance, and complying with following requirements:

1. Bond Strength: 150 pounds per square foot (7.2 kPa), minimum, when tested in accordance with ASTM E736/E736M when set and dry.
2. Dry Density: As required by fire resistance design.
3. Compressive Strength: 8.33 pounds per square inch (57.4 kPa), minimum.
4. Effect of Impact on Bonding: No cracking, spalling or delamination, when tested in accordance with ASTM E760/E760M.
5. Corrosivity: No evidence of corrosion, when tested in accordance with ASTM E937/E937M.
6. Air Erosion Resistance: Weight loss of 0.025 g/sq ft (0.27 g/sq m), maximum, when tested in accordance with ASTM E859/E859M after 24 hours.
7. Surface Burning Characteristics: Maximum flame spread index of 0 (zero) and maximum smoke developed index of 0 (zero), when tested in accordance with ASTM E84.
8. Provide product that is of similar type to existing fire protection, and is compatible with existing fire protection material.

### 2.3 ACCESSORIES

- A. Primer Coating: Of type recommended by applied fire protection manufacturer.
- B. Water: Clean, potable.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that surfaces are ready to receive fireproofing.
- B. Verify that clips, hangers, supports, sleeves, and other items required to penetrate fireproofing are in place.
- C. Verify that ducts, piping, equipment, or other items that would interfere with application of fireproofing have not been installed.

### 3.2 PREPARATION

- A. Perform tests as recommended by fireproofing manufacturer in applications where adhesion of fireproofing to substrate is in question.
- B. Remove incompatible materials that could affect bond by scraping, brushing, scrubbing, or sandblasting.
- C. Prepare substrates to receive fireproofing in strict accordance with instructions of fireproofing manufacturer.
- D. Protect surfaces not scheduled for fireproofing and equipment from damage by overspray, fall-out, and dusting.
- E. Close off and seal duct work in areas where fireproofing is being applied.

### 3.3 APPLICATION

- A. Apply primer coating in accordance with manufacturer's instructions.
- B. Apply fireproofing in uniform thickness and density as necessary to achieve required ratings.



### 3.4 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 01 40 00 - Quality Requirements.
- B. Inspect installed fireproofing after application and curing for integrity, prior to its concealment.
  - 1. Submit field test reports promptly to Contractor and Architect/Engineer.
- C. Ensure that actual thicknesses, densities, and bond strengths meet requirements for specified ratings and requirements of authorities having jurisdiction (AHJ).
- D. Re-inspect installed fireproofing for integrity of fire protection, after installation of subsequent Work.

### 3.5 CLEANING

- A. Remove excess material, overspray, droppings, and debris.

**END OF SECTION**

SECTION 07 84 00  
FIRESTOPPING

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Firestopping systems.
- B. Firestopping of all joints and penetrations in fire resistance rated and smoke resistant assemblies, whether indicated on drawings or not.
- C. Labeling of firestopping assemblies.

1.2 REFERENCE STANDARDS

- A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).
- C. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestops; 2014.
- D. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers; 2010a.
- E. ASTM E2837 - Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed between Rated Wall Assemblies and Nonrated Horizontal Assemblies; 2023a.
- F. ICC (IBC) - International Building Code; 2015.
- G. ITS (DIR) - Directory of Listed Products; current edition.
- H. FM (AG) - FM Approval Guide; current edition.
- I. UL 1479 - Standard for Fire Tests of Penetration Firestops; Current Edition, Including All Revisions.
- J. UL (DIR) - Online Certifications Directory; Current Edition.
- K. UL (FRD) - Fire Resistance Directory; Current Edition.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.
- C. Product Data: Provide data on product characteristics, performance ratings, and limitations.
- D. Installer's qualification statement.

1.4 QUALITY ASSURANCE

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
  - 1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.

2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at [www.icc-es.org](http://www.icc-es.org) will be considered as constituting an acceptable test report.
- B. Installer Qualifications:
1. Trained by manufacturer.

## 1.5 FIELD CONDITIONS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.
- B. Provide ventilation in areas where solvent-cured materials are being installed.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. Firestopping Materials: Any materials meeting requirements.
- B. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.
- C. Fire Ratings: Refer to drawings for required systems and ratings.

### 2.2 FIRESTOPPING ASSEMBLY REQUIREMENTS

- A. Head-of-Wall (HW) Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal Assemblies: Use system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of wall assembly.
  1. Air Leakage: In addition, at smoke barriers, provide systems that have been tested to show L Rating as indicated.
  2. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.

### 2.3 FIRESTOPPING ASSEMBLY IDENTIFICATION

- A. Regulatory Requirements: Comply with "Marking and Identification" requirements of "Fire-Resistance Ratings and Fire Tests" chapter of ICC (IBC).
- B. Adhered Fire and Smoke Assembly Identification Signs: Printed vinyl or metal sign with factory applied adhesive backing.
- C. Include the following information on labels:
  1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
  2. Contractor's name, address, and phone number.
  3. Designation of applicable testing and inspecting agency.
  4. Date of installation.
  5. Manufacturer's name.
  6. Installer's name.
- D. Languages: Provide all markings in English.

## 2.4 FIRESTOPPING SYSTEMS

A. Firestopping: Any material meeting requirements.

1. Fire Ratings: Use system that is listed by FM (AG), ITS (DIR), or UL (FRD) and tested in accordance with ASTM E814, ASTM E119, or UL 1479 with F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal to F Rating and in compliance with other specified requirements.

## PART 3 EXECUTION

### 3.1 EXAMINATION

A. Verify openings are ready to receive the work of this section.

### 3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.
- C. Install backing materials to prevent liquid material from leakage.

### 3.3 INSTALLATION

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Do not cover installed firestopping until inspected by Owner's Independent Testing Agency.
- C. Do not cover installed firestopping until inspected by authorities having jurisdiction.
- D. Install labeling required by code.

### 3.4 IDENTIFICATION

- A. Attach labels permanently to surfaces adjacent to and within 6 inches of joint and penetration firestopping edge, so labels will be visible to anyone seeking to remove penetrating items or firestopping.

### 3.5 FIELD QUALITY CONTROL

- A. Independent Testing Agency: Inspection agency employed and paid by Owner, will examine penetration firestopping in accordance with ASTM E2174, and ASTM E2393.
- B. Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do not meet specified requirements.

### 3.6 CLEANING

A. Clean adjacent surfaces of firestopping materials.

### 3.7 PROTECTION

A. Protect adjacent surfaces from damage by material installation.

**END OF SECTION**

SECTION 07 92 00  
JOINT SEALANTS

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Nonsag gunnable joint sealants.
- B. Self-leveling pourable joint sealants.
- C. Joint backings and accessories.

1.2 REFERENCE STANDARDS

- A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2015.
- B. ASTM C834 - Standard Specification for Latex Sealants; 2017 (Reapproved 2023).
- C. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2022.
- D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- E. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).
- F. ASTM C1311 - Standard Specification for Solvent Release Sealants; 2022.
- G. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2018.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
  - 1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
  - 2. List of backing materials approved for use with the specific product.
  - 3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
  - 4. Substrates the product should not be used on.
  - 5. Substrates for which use of primer is required.
  - 6. Substrates for which laboratory adhesion and/or compatibility testing is required.
  - 7. Installation instructions, including precautions, limitations, and recommended backing materials and tools.
  - 8. Sample product warranty.
- C. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.
- D. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

#### 1.5 MOCK-UP

- A. Provide joint sealants for installation in mock-up of exterior wall.
- B. See Section 01 4000-Quality Requirements for additional requirements.

#### 1.6 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion.
- C. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal , exhibit loss of adhesion or cohesion, or do not cure.

### **PART 2 PRODUCTS**

#### 2.1 MANUFACTURERS

- A. Non-Sag Sealants: Permits application in joints on vertical surfaces without sagging or slumping.
  - 1. Dow Corning Corporation: [www.dowcorning.com/construction/sle](http://www.dowcorning.com/construction/sle).
  - 2. Master Builders Solutions by BASF: [www.master-builders-solutions.basf.us/en-us/#sle](http://www.master-builders-solutions.basf.us/en-us/#sle).
  - 3. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
  - 4. Sherwin-Williams Company: [www.sherwin-williams.com](http://www.sherwin-williams.com).
  - 5. Sika Corporation: [www.usa-sika.com](http://www.usa-sika.com).
  - 6. Tremco Commercial Sealants & Waterproofing: [www.tremcosealants.com/#sle](http://www.tremcosealants.com/#sle).
  - 7. W.R. Meadows, Inc: [www.wrmeadows.com/sle](http://www.wrmeadows.com/sle).
  - 8. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Self-Leveling Sealants: Pourable or self-leveling sealant that has sufficient flow to form a smooth, level surface when applied in a horizontal joint.
  - 1. Dow Corning Corporation: [www.dowcorning.com/construction/sle](http://www.dowcorning.com/construction/sle).
  - 2. Master Builders Solutions by BASF: [www.master-builders-solutions.basf.us/en-us/#sle](http://www.master-builders-solutions.basf.us/en-us/#sle).
  - 3. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
  - 4. Sherwin-Williams Company: [www.sherwin-williams.com](http://www.sherwin-williams.com).
  - 5. Sika Corporation: [www.usa-sika.com](http://www.usa-sika.com).
  - 6. Tremco Commercial Sealants & Waterproofing: [www.tremcosealants.com/#sle](http://www.tremcosealants.com/#sle).
  - 7. W.R. Meadows, Inc: [www.wrmeadows.com/sle](http://www.wrmeadows.com/sle).
  - 8. Substitutions: See Section 01 60 00 - Product Requirements.

#### 2.2 JOINT SEALANT APPLICATIONS

- A. Scope:

1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
  - a. Joints between door, window, and other frames and adjacent construction.
  - b. Joints between different exposed materials.
  - c. Other joints indicated below.
2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
  - a. Joints between door, window, and other frames and adjacent construction.
  - b. In sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, piping, and other openings; between wall/ceiling and other construction; and other flanking sound paths.
  - c. Other joints indicated below.
3. Do not seal the following types of joints.
  - a. Intentional weepholes in masonry.
  - b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
  - c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
  - d. Joints where installation of sealant is specified in another section.
  - e. Joints between suspended panel ceilings/grid and walls.
- B. Exterior Joints: Use non-sag non-staining silicone sealant, unless otherwise indicated.
  1. Lap Joints in Sheet Metal Fabrications: Butyl rubber, non-curing.
- C. Interior Joints: Use non-sag polyurethane sealant, unless otherwise indicated.
  1. Wall and Ceiling Joints in Non-Wet Areas: Acrylic emulsion latex sealant.
  2. In Sound-Rated Assemblies: Acrylic emulsion latex sealant.
  3. Other Floor Joints: Self-leveling polyurethane "traffic-grade" sealant.
- D. Sound-Rated Assemblies: Walls and ceilings identified as "STC-rated", "sound-rated", or "acoustical".

### 2.3 NONSAG JOINT SEALANTS

- A. Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
  1. Movement Capability: Plus and minus 25 percent, minimum.
  2. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
  3. Color: Match adjacent finished surfaces, to be approved by Architect.
  4. Service Temperature Range: Minus 20 to 180 degrees F (Minus 29 to 82 degrees C).
- B. Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.
  1. Color: White.

- C. Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; not expected to withstand continuous water immersion or traffic.
- D. Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use.
  - 1. Color: Standard colors matching finished surfaces, Type OP (opaque).
- E. ---- Unique Water-Based Elastomeric Acrylic Latex, Interior and Exterior Use ----
- F. Non-Curing Butyl Sealant: Solvent-based; ASTM C1311; single component, non-sag, non-skinning, non-hardening, non-bleeding; vapor-impermeable; intended for fully concealed applications.
- G. Self-Leveling Polyurethane Sealant: ASTM C920, Grade P, Uses M and A; single or multi-component; explicitly approved by manufacturer for traffic exposure; not expected to withstand continuous water immersion.
  - 1. Movement Capability: Plus and minus 25 percent, minimum.
  - 2. Hardness Range: 35 to 55, Shore A, when tested in accordance with ASTM C661.
- H. Rigid Self-Leveling Polyurethane Joint Filler: Two part, low viscosity, fast setting; intended for cracks and control joints not subject to significant movement.

## 2.4 ACCESSORIES

- A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
  - 1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type O - Open Cell Polyurethane.
  - 2. Open Cell: 40 to 50 percent larger in diameter than joint width.
- B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.
- C. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.
- D. Joint Cleaner: Non-corrosive and non-staining type, type recommended by sealant manufacturer; compatible with joint forming materials.
- E. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that joints are ready to receive work.
- B. Verify that backing materials are compatible with sealants.
- C. Verify that backer rods are of the correct size.

### 3.2 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.



- D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

### 3.3 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Perform acoustical sealant application work in accordance with ASTM C919.
- D. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
- E. Install bond breaker backing tape where backer rod cannot be used.
- F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
- G. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
- H. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

**END OF SECTION**

SECTION 08 11 13  
HOLLOW METAL DOORS AND FRAMES

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Non-fire-rated hollow metal doors and frames.
- B. Fire-rated hollow metal doors and frames.
- C. Accessories, including glazing.

1.2 ABBREVIATIONS AND ACRONYMS

- A. ANSI: American National Standards Institute.
- B. HMMA: Hollow Metal Manufacturers Association.
- C. NAAMM: National Association of Architectural Metal Manufacturers.
- D. NFPA: National Fire Protection Association.
- E. SDI: Steel Door Institute.
- F. UL: Underwriters Laboratories.

1.3 REFERENCE STANDARDS

- A. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames; 2003 (R2009).
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- C. ASTM C1363 - Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus; 2019.
- D. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2015a.
- E. ASTM C476 - Standard Specification for Grout for Masonry; 2022.
- F. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2019.
- G. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- H. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2011.
- I. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames; 2003 (R2009).
- J. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2017.
- K. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2011.
- L. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- M. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2018.

- N. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2018a.
- O. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2015a.
- P. ASTM C476 - Standard Specification for Grout for Masonry; 2022.
- Q. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- R. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames; 2016.
- S. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- T. ITS (DIR) - Directory of Listed Products; current edition.
- U. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.
- V. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.
- W. NAAMM HMMA 840 - Guide Specifications For Receipt, Storage and Installation of Hollow Metal Doors and Frames; 2007.
- X. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; 2014.
- Y. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2019.
- Z. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2019.
- AA. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.
- BB. UL (DIR) - Online Certifications Directory; Current Edition.
- CC. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- DD. ASTM C1363 - Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus
- EE. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

#### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section.
- B. Maintain at project site copies of reference standards relating to installation of products specified.
- C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.
- C. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use non-vented plastic.
  - 1. Provide additional protection to prevent damage to finish of factory-finished units.
- D. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- E. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch (102 mm) high wood blocking. Do not store in manner that traps excess humidity.
  - 1. Provide minimum 1/4 inch (6 mm) space between each stacked doors to permit air circulation.

## 1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

## 1.8 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. Ceco Door, an Assa Abloy Group company: [www.assaabloydss.com/#sle](http://www.assaabloydss.com/#sle).
  - 2. Curries, an Assa Abloy Group company: [www.assaabloydss.com/#sle](http://www.assaabloydss.com/#sle).
  - 3. Steelcraft, an Allegion brand: [www.allegion.com/#sle](http://www.allegion.com/#sle).
  - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. MATERIALS
  - 1. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
  - 2. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum A40 (ZF120) metallic coating.
  - 3. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40z (12G) coating designation; mill phosphatized.
    - a. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M, hot-dip galvanized according to ASTM A153/A153M, Class B.

4. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A153M.
5. Glazing: Comply with requirements in Division 08 Section "Glazing"
6. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4 mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

## 2.2 PERFORMANCE REQUIREMENTS

### A. Requirements for Hollow Metal Doors and Frames:

1. Steel Sheet: Comply with one or more of the following requirements; galvanized steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
2. Accessibility: Comply with ICC A117.1 and ADA Standards.
3. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.
4. Door Edge Profile: Hinged edge square, and lock edge beveled.
5. Typical Door Face Sheets: Flush.
6. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturers standard.
7. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
8. Zinc Coating for Typical Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvanized) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.

B. Thermal Insulated Door Assembly: Maximum U-Factor of 0.37, measured in accordance with ASTM C1363.

C. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being tornado-resistant must comply with the requirements specified for exterior doors and for tornado-resistant doors; where two requirements conflict, comply with the most stringent.

## 2.3 HOLLOW METAL DOORS

A. Door Finish: Factory primed and field finished.

B. Exterior Doors: Thermally insulated.

C. Owner requirements: SDI Level 3, Extra Heavy Duty, Model 2, seamless design, 0.053 inch (nom. 16-gage) thick, zinc coated steel. "Seamless design" means all seams on the vertical edges are continuously welded the full height of the door, filled, and finished smooth for no visible seams.

1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
  - a. Level 3 - Extra Heavy-duty.
  - b. Physical Performance Level A 1 000 000 cycles; in accordance with ANSI/SDI A250.4.
  - c. Model 2, seamless design, continuously welded seam dressed smooth.

- d. Door Face Metal Thickness: 16 gauge, 0.053 inch (1.3 mm), minimum.
  - e. Zinc Coating: A60/ZF180 galvanized coating; ASTM A653/A653M.
2. Door Core Material: Manufacturer's standard core material/construction and in compliance with requirements.
    - a. Foam Plastic Insulation: Manufacturer's standard board insulation with maximum flame spread index (FSI) of 75, and maximum smoke developed index (SDI) of 450 in accordance with ASTM E84, and completely enclosed within interior of door.
  3. Door Thickness: 1-3/4 inches (44.5 mm), nominal.
  4. Weatherstripping: Refer to Section 08 71 00.
- D. Interior Doors, Non-Fire-Rated:
1. Owner requirements: Interior Doors to be SDI Level 2, Heavy Duty, Model 2, seamless design, 0.042 inch (nom. 18 gage) thick zinc coated steel. "Seamless design" means all seams on the vertical edges are continuously welded the full height of the door, filled, and finished smooth for no visible seams.
  2. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    - a. Level 2 - Heavy-duty.
    - b. Physical Performance Level B 500 000 cycles; in accordance with ANSI/SDI A250.4.
    - c. Model 2, seamless design, continuously welded seam dressed smooth.
    - d. Door Face Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.
  3. Door Core Material: Manufacturer's standard core material/construction and in compliance with requirements.
  4. Door Thickness: 1-3/4 inches (44.5 mm), nominal.
  5. All exterior door shall be closed flush at the top and bottom edges. Install minimum 20 gage channels (legs down at top of door, legs up at bottom of door) even with the top and bottom edges of door face sheets (no recesses). Seam wire weld continuous or spot weld around entire perimeter of channel. Fill all welds and seams and flush smooth for no visible seams. Provide openings in the bottom closure channel to permit the escape of entrapped moisture.
- E. Interior Doors, Fire-Rated:
1. Owner requirements: Interior Doors to be SDI Level 2, Heavy Duty, Model 2, seamless design, 0.042 inch (nom. 18 gage) thick zinc coated steel. "Seamless design" means all seams on the vertical edges are continuously welded the full height of the door, filled, and finished smooth for no visible seams.
  2. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
  3. Level 2 - Heavy-duty.
  4. Physical Performance Level B 500 000 cycles; in accordance with ANSI/SDI A250.4.
  5. Model 2, seamless design, continuously welded seam dressed smooth.
  6. Door Face Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.
  7. Zinc Coating: A60/ZF180 galvanized coating; ASTM A653/A653M.
  8. Thickness: 1 3/4"
  9. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").

- a. Provide units listed and labeled by UL (DIR) or ITS (DIR).
- b. Attach fire rating label to each fire rated unit.
- c. Smoke and Draft Control Doors ( including all fire-rated doors ): Self-closing or automatic closing doors in accordance with NFPA 80 and NFPA 105, with fire-resistance-rated wall construction rated the same or greater than the fire-rated doors, and the following;
  - 1) Maximum Air Leakage: 3.0 cfm/sq ft (0.02 cu m/sec/sq m) of door opening at 0.10 inch w.g. (24.9 Pa) pressure, when tested in accordance with UL 1784 at both ambient and elevated temperatures.
  - 2) Gasketing: Provide gasketing or edge sealing as necessary to achieve leakage limit.
  - 3) Label: Include the "S" label on fire-rating label of door.
- 10. Door Core Material: Manufacturers standard core material/construction in compliance with requirements.
- 11. Door Thickness: 1-3/4 inches (44.5 mm), nominal.

#### 2.4 HOLLOW METAL FRAMES

- A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
- B. Frame Finish: Factory primed and field finished.
- C. Exterior Door Frames: full-profile welded: grind, fill, dress and make smooth, flush and invisible
  - 1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A60/ZF180 coating.
  - 2. Frame Metal Thickness: 14 gage, 0.067 inch (1.7 mm), minimum.
- D. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
  - 1. Frame Metal Thickness: 16 gage, 0.053 inch (1.3 mm), minimum.
- E. Door Frames, Fire-Rated: Full profile/continuously welded type.
  - 1. Fire Rating: Same as door, labeled.
  - 2. Frame Metal Thickness: 16 gage, 0.053 inch (1.3 mm), minimum.
- F. Mullions for Pairs of Doors: As specified in section 08 7100.
- G. Transom Bars: Fixed, of profile same as jamb and head.
- H. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.
- I. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches (102 mm) high to fill opening without cutting masonry units.
- J. Frames Wider than 48 inches (1219 mm): Reinforce with steel channel fitted tightly into frame head, flush with top.

#### 2.5 FINISHES

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

## 2.6 ACCESSORIES

- A. Glazing: As specified in Section 08 80 00.
- B. Removable Stops: Formed sheet steel, channel shape, mitered or butted corners; prepared for countersink style tamper proof screws.
- C. All cut ends of material (i.e. glazing stops) must be primed and painted.
- D. Astragals for Double Doors:
  - 1. Exterior Doors: Steel, Z-shaped.
  - 2. Fire-Rated Doors: Steel, shape as required for fire rating.
- E. Mechanical Fasteners for Concealed Metal-to-Metal Connections: Self-drilling, self-tapping, steel with electroplated zinc finish.
- F. Frame Anchors
  - 1. Jamb Anchors:
    - a. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (50 mm) wide by 10 inches (250 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.
    - b. Post-installed Expansion Type for In-Place Concrete or Masonry: Minimum 3/8 inch (9.5 mm) diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
  - 2. Floor Anchors: Formed from same material as frames, not less than 0.042 inch (1.0 mm) thick, and as follows:
    - a. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
- G. Grout for Frames: Mortar grout complying with ASTM C476 with maximum slump of 4 inches (102 mm) as measured in accordance with ASTM C143/C143M for hand troweling in place; plaster grout and thinner pumpable grout are prohibited.
- H. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.
- I. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.
- J. Electrical Knock-Out Boxes: 18 gage, two-piece assembly; box welded to frame, with removable cover:
  - 1. Provide electrical knock-out boxes with dual 1/2 and 3/4 inch knockouts.
  - 2. Electrical knock-out boxes shall comply with NFPA requirements, and fit electrified door hardware specified in Section 08 71 00 and provided by Owner' s separate access control contractor.
  - 3. Provide electrical knock-out boxes for electrified hardware preps for electric power transfers, door position switches, electric locks, jamb mounted auto door operator switches, and jamb mounted card readers.

## 2.7 FABRICATION

- A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for 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.
- 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. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
  - 5. Jamb Anchors: Provide number and spacing of anchors as follows:
    - a. Fire ratings may require additional anchors.
    - b. Masonry Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
      - 1) Two anchors per jamb up to 60 inches (1524 mm) high.
      - 2) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
    - c. Post-installed Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.
  - 6. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised 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."
    - a. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
    - b. Reinforce doors and frames to receive non-templated, mortised and surface-mounted door hardware.
    - c. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
    - d. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.
  - 7. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
    - a. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
    - b. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.

- c. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.
8. Drips: Continuous, welded, across head of each exterior door not protected by a canopy.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that finished walls are in plane to ensure proper door alignment.
- D. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- E. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Coat inside of non-rated frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.
- B. 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.
- C. Drill and tap doors and frames to receive non-templated, mortised, and surface-mounted door hardware.

### **3.3 INSTALLATION**

- A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
- B. Install fire rated units in accordance with NFPA 80.
- C. Coordinate frame anchor placement with wall construction.
- D. All frames in new masonry walls to be filled with cementitious based grout (mortar) as walls are laid up. Rubber door silencer buttons MUST be installed prior to filling. Gypsum based grout in frames is prohibited.
- E. All frames in non-masonry walls or frames insert into existing openings or openings cut into existing masonry walls shall be un-grouted. Stuff with fiberglass batt insulation for sound deadening.
- F. Frames identified to receive rough-in for Electronic Security Systems shall have the mortar boxes and conduits within the frames installed by the frame manufacturer. Install mortar boxes regardless of whether or not the frame will be grouted.
- G. Coat the inside of exterior frames with a corrosion inhibiting bituminous material.
- H. Frames to be securely anchored to the structural portion of the wall and not the brick veneer.
- I. Install door hardware as specified in Section 08 71 00.

1. Comply with recommended practice for hardware placement of doors and frames in accordance with ANSI/SDI A250.6 or NAAMM HMMA 861.
- J. Comply with glazing installation requirements of Section 08 80 00.
- K. Coordinate installation of electrical connections to electrical hardware items.
- L. 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.
    - b. Install frames with removable glazing stops located on secure side of opening.
    - c. Install door silencers in frames before grouting.
  2. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
  3. In-Place Concrete or Masonry Construction: Secure frames in place with post-installed expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.

#### 3.4 TOLERANCES

- A. Maximum Diagonal Distortion: 1/16 inch (1.6 mm) measured with straight edge, corner to corner.

#### 3.5 ADJUSTING

- A. Adjust for smooth and balanced door movement.
- B. 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.
- C. Remove grout and other bonding material from hollow metal work immediately after installation.
- D. 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.
- E. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

#### 3.6 SCHEDULE

- A. Refer to Door and Frame Schedule on the drawings.

**END OF SECTION**

SECTION 08 43 13  
ALUMINUM-FRAMED STOREFRONTS

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Aluminum-framed storefront, with vision glass.
- B. Infill panels of glass.
- C. Aluminum doors.
- D. Weatherstripping.

1.2 RELATED REQUIREMENTS

- A. Section 07 25 00 - Weather Barriers: Sealing framing to weather barrier installed on adjacent construction.
- B. Section 07 92 00 - Joint Sealants: Sealing joints between frames and adjacent construction.
- C. Section 08 71 00 - Door Hardware: Hardware items other than specified in this section.
- D. Section 08 80 00 - Glazing: Glass and glazing accessories.

1.3 REFERENCE STANDARDS

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; 2015.
- B. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2014 (2015 Errata).
- C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- D. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.
- E. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with installation of other components that comprise the exterior enclosure.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, and internal drainage details.
- C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.
  - 1. Include design engineer's stamp or seal on shop drawings for attachments and anchors.
- D. Samples: Submit two samples illustrating finished aluminum surface.

- E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

#### 1.6 QUALITY ASSURANCE

- A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.
- B. Source Limitations: Obtain the storefront from a single manufacturer list in Section 2.1.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

#### 1.8 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F (5 degrees C). Maintain this minimum temperature during and 48 hours after installation.

#### 1.9 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a two year period after Date of Substantial Completion.
- C. Provide ten year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
- D. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

### **PART 2 PRODUCTS**

#### 2.1 MANUFACTURERS

- A. Basis of Design: Tubelite Inc. T14000 I/O outboard set plane Storefront, 2 inches x 4-1/2 inches thermal.
- B. Other Acceptable - Aluminum-Framed Storefronts Manufacturers:
  - 1. Kawneer North America: [www.kawneer.com/#sle](http://www.kawneer.com/#sle).
  - 2. Oldcastle BuildingEnvelope: [www.oldcastlebe.com/#sle](http://www.oldcastlebe.com/#sle).
  - 3. Substitutions: See Section 01 60 00 - Product Requirements.

#### 2.2 FRAMING FOR MONOLITHIC GLAZING

- A. Outboard Set Style:
  - 1. Basis of Design: Tubelite Inc. E14000 Center Plane Storefront, 2 inches x 4-1/2 inches non-thermal: [www.tubeliteinc.com](http://www.tubeliteinc.com).
  - 2. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep (50 mm wide by 114 mm deep).
- B. Other Manufacturers: Provide either the product identified as "Basis of Design" or an equivalent product of one of the manufacturers listed below:

1. Kawneer North America: [www.kawneer.com/#sle](http://www.kawneer.com/#sle).
  2. Oldcastle BuildingEnvelope: [www.oldcastlebe.com/#sle](http://www.oldcastlebe.com/#sle).
- C. Substitutions: See Section 01 60 00 - Product Requirements.
1. For any product not identified as "Basis of Design", submit information as specified for substitutions.

## 2.3 SWINGING DOORS

- A. Manufacturer: Same as storefront framing.
- B. Wide Stile, Monolithic Glazing:
1. Thickness: 1-3/4 inches (43 mm).
  2. Bottom Rail: 10 inches.
- C. Wide Stile, Insulating Glazing, Not Thermally-Broken:
1. Thickness: 1-3/4 inches (43 mm).
  2. Bottom Rail: 10 inches.

## 2.4 ALUMINUM-FRAMED STOREFRONT

- A. Aluminum-Framed Storefront: Factory fabricated, field glazed, factory finished aluminum framing members with infill, screw spline construction with infill and related flashings, anchorage and attachment devices.
1. Glazing Rabbet: For 1 inch (25 mm) insulating glazing.
  2. Glazing Rabbet: For 1/4 inch monolithic glazing.
  3. Finish: Class I color anodized.
    - a. Factory finish all surfaces that will be exposed in completed assemblies.
    - b. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
  4. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
  5. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
  6. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
  7. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F (95 degrees C) over a 12-hour period without causing detrimental effect to system components, anchorages, and other building elements.
  8. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
  9. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
- B. Performance Requirements

1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
  - a. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
2. Thermal Performance Requirements:
  - a. Fixed Glazing: Overall U-Value: 0.38 Btu/(hr sq ft deg F), maximum, including glazing.
  - b. Entrances: Overall U-value: 0.77 Btu/(hr sq ft deg F), maximum.

## 2.5 COMPONENTS

- A. Exterior Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
  1. Glazing Stops: Flush.
- B. Interior Aluminum Framing Members: Tubular aluminum sections.
  1. Glazing Stops: Flush.
- C. Glazing: As specified in Section 08 80 00.
  1. For Exterior Framing: Type IG1.
  2. For Interior Framing: Type G1.
- D. Swing Doors: Glazed aluminum.
  1. Thickness: 1-3/4 inches (43 mm).
  2. Top Rail: 5 inches (127 mm) wide.
  3. Vertical Stiles: 5 inches (127 mm) wide.
  4. Bottom Rail: 10 inches (254 mm) wide.
  5. Glazing Thickness: 1 inch insulating at exterior locations.
  6. Glazing Thickness: 1/4 inch monolithic at interior locations.
  7. Glazing Stops: Square.
  8. Finish: Same as storefront.
  9. Door Construction: With tie rods and corner welded or welded corners.

## 2.6 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Fasteners: Stainless steel.
- C. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

## 2.7 FINISHES

- A. Class I Color Anodized Finish: AAMA 611 AA-M12C22A42 Integrally colored anodic coating not less than 0.7 mils (0.018 mm) thick.
- B. Color: Dark bronze.

## 2.8 HARDWARE

- A. Door Hardware: As specified in Section 08 71 00.

## **PART 3 EXECUTION**

### 3.1 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other work.
- B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

### 3.2 INSTALLATION

- A. Install wall system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.
- F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form watertight dam.
- G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
- H. Pack mineral wool insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- I. Install glass in accordance with Section 08 80 00, using glazing method required to achieve performance criteria.
- J. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

### 3.3 TOLERANCES

- A. Maximum Variation from Plumb: 0.06 inch per 3 feet (1.5 mm per m) non-cumulative or 0.06 inch per 10 feet (1.5 mm per 3 m), whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch (0.8 mm).

### 3.4 FIELD QUALITY CONTROL

- A. Provide services of storefront manufacturer's field representative to observe for proper installation of system and submit report.

### 3.5 ADJUSTING

- A. Adjust operating hardware for smooth operation.

### 3.6 CLEANING

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.



3.7 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

**END OF SECTION**

SECTION 08 71 00  
DOOR HARDWARE

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Hardware for aluminum and hollow metal doors.
- B. Hardware for fire-rated doors.
- C. Electrically operated and controlled hardware.
- D. Thresholds.
- E. Weatherstripping and gasketing.

1.2 RELATED REQUIREMENTS

- A. Section 07 92 00 - Joint Sealants: Sealants for setting exterior door thresholds.
- B. Section 08 11 13 - Hollow Metal Doors and Frames.
- C. Section 08 43 13 - Aluminum-Framed Storefronts: Door hardware, except as noted in section.
- D. Section 10 14 00 - Signage: Additional signage requirements.
- E. Section 28 10 00 - Access Control: Electronic access control devices.

1.3 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. BHMA A156.1 - Standard for Butts and Hinges; 2021.
- C. BHMA A156.3 - American National Standard for Exit Devices; 2014.
- D. BHMA A156.4 - Door Controls - Closers; 2019.
- E. BHMA A156.5 - American National Standard for Cylinders and Input Devices for Locks; 2014.
- F. BHMA A156.6 - Standard for Architectural Door Trim; 2021.
- G. BHMA A156.7 - Template Hinge Dimensions; 2016.
- H. BHMA A156.8 - Door Controls - Overhead Stops and Holders; 2021.
- I. BHMA A156.13 - American National Standard for Mortise Locks & Latches Series 1000; 2017.
- J. BHMA A156.15 - Release Devices - Closer Holder, Electromagnetic and Electromechanical; 2021.
- K. BHMA A156.16 - Auxiliary Hardware; 2023.
- L. BHMA A156.18 - Materials and Finishes; 2020.
- M. BHMA A156.21 - Thresholds; 2019.
- N. BHMA A156.22 - Standard for Gasketing; 2021.
- O. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames; 2016.
- P. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- Q. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2019.

- R. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- S. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2019.
- T. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.
- U. UL (DIR) - Online Certifications Directory; Current Edition.
- V. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- W. UL 437 - Standard for Key Locks; Current Edition, Including All Revisions.
- X. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on.
- B. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.
- C. Keying:
  - 1. Keyed to Owner's requirements. All keying and coordination shall be by hardware supplier. Coordinate Owner's keying requirements during course of Work. Upon return of reviewed finish hardware schedule, arrange a keying requirements meeting.
  - 2. Provide temporary construction cores for all key removable core cylinders.
  - 3. Provide 3 cut keys per door plus an additional 3 blank keys per door to be cut as directed by Owner. (Add as a Hardware Group).
  - 4. Provide an additional ten percent extra cores for Owner's future use (Add as a Hardware Group).
- D. Keying Requirements Meeting:
  - 1. Schedule meeting upon return of reviewed finish hardware schedule.
  - 2. Attendance Required:
    - a. Contractor.
    - b. Owner.
    - c. Architect/Engineer.
    - d. Hardware Supplier.
    - e. Hardware Installer.
  - 3. Agenda:
    - a. Establish owner keying requirements.
    - b. Verify locksets and locking hardware are functionally correct for project requirements.
    - c. Verify that keying and programming complies with project requirements.
  - 4. Incorporate "Keying Requirements Meeting" decisions into keying submittal upon review of door hardware keying system including, but not limited to, the following:
    - a. Access control requirements.

5. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect/Engineer, Owner, participants, and those affected by decisions made.
6. Deliver established keying requirements to manufacturers.

## 1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project, and includes construction details, material descriptions, finishes, and dimensions and profiles of individual components.
- C. Shop Drawings - Door Hardware Schedule: Submit detailed listing that includes each item of hardware to be installed on each door. Use door numbering scheme as included in Contract Documents.
  1. Prepared by or under supervision of Architectural Hardware Consultant (AHC).
  2. Provide complete description for each door listed.
- D. Shop Drawings - Electrified Door Hardware: Submit diagrams for power, signal, and control wiring for electrified door hardware that include details of interface with building safety and security systems. Provide elevations and diagrams for each electrified door opening as follows:
  1. Prepared by or under supervision of Architectural Hardware Consultant (AHC) and Electrified Hardware Consultant (EHC).
  2. Elevations: Submit front and back elevations of each door opening showing electrified devices with connections installed and an operations narrative describing how opening operates from either side at any given time.
  3. Diagrams: Submit point-to-point wiring diagram that shows each device in door opening system with related colored wire connections to each device.
- E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- F. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.
- G. Keying Schedule:
  1. Submit Keying Schedule in compliance with requirements established during Keying Requirements Meeting unless otherwise indicated.
- H. Supplier's Qualification Statement.
  1. Hardware Supplier Personnel: Employ Architectural Hardware Consultant (AHC) qualified person to assist in work of this section.
- I. Warranty: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- J. Project Record Documents: Record actual locations of concealed equipment, services, and conduit.
- K. Provide bitting list with set-up chart to Owner at Project Closeout.

## 1.6 QUALITY ASSURANCE

- A. Supplier Qualifications:
  1. Hardware Supplier Personnel: Employ Architectural Hardware Consultant (AHC) qualified person to assist in work of this section.

## 1.7 WARRANTY

- A. Warranty against defects in material and workmanship for period indicated, from Date of Substantial Completion.
  - 1. Exit Devices: Three years, minimum.
  - 2. Locksets and Cylinders: Three years, minimum.
  - 3. Continuous Hinges: Lifetime warranty.
  - 4. Other Hardware: Two years, minimum.

## PART 2 PRODUCTS

### 2.1 DESIGN AND PERFORMANCE CRITERIA

- A. Provide specified door hardware as required to make doors fully functional, compliant with applicable codes, and secure to extent indicated.
- B. Provide individual items of single type, of same model, and by same manufacturer.
- C. Provide door hardware products that comply with the following requirements:
  - 1. Hardware for Smoke and Draft Control Doors: Provide door hardware that complies with local codes, and requirements of assemblies tested in accordance with UL 1784.
  - 2. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified.
- D. Electrically Operated and/or Controlled Hardware: Provide necessary power supplies, power transfer hinges, relays, and interfaces as required for proper operation; provide wiring between hardware and control components and to building power connection in compliance with NFPA 70.

### 2.2 HINGES

- A. Manufacturers:
  - 1. McKinney; an Assa Abloy Group company; TA/T4A Series: [www.assaabloydss.com/#sle](http://www.assaabloydss.com/#sle).
  - 2. Ives; 5BB Series: [www.us.allegion.com/#sle](http://www.us.allegion.com/#sle).
  - 3. Hager Companies; BB Series: [www.hagerco.com/#sle](http://www.hagerco.com/#sle).
  - 4. Stanley, dormakaba Group; FBB Series: [www.stanleyhardwarefordoors.com/#sle](http://www.stanleyhardwarefordoors.com/#sle).
- B. Hinges: Comply with BHMA A156.1, Grade 1.
  - 1. Provide hinges on every swinging hollow metal door.
  - 2. Provide non-removable pins on all exterior doors.
  - 3. Provide power transfer hinges where electrified hardware is mounted in door leaf.
  - 4. Provide following quantity of butt hinges for each door:
    - a. All exterior doors: Four hinges each leaf.
    - b. Interior doors From 60 inches (1.5 m) High up to 90 inches (2.3 m) High: Three hinges each leaf.
  - 5. Exterior hinges to be stainless steel with non-removal hinge pins. All pins and fasteners to be stainless steel.

6. Width of hinges: 4-1/2 inches (114 mm) at 1-3/4 inch (44 mm) thick doors, and 5 inches (127 mm) at 2 inches (51 mm) or thicker doors. Adjust hinge width as required for door, frame, and wall conditions to allow proper degree of opening.

## 2.3 ALUMINUM CONTINUOUS GEARED HINGES

### A. Manufacturers:

1. Ives; XY Series: [www.us.allegion.com/#sle](http://www.us.allegion.com/#sle).
2. Stanley, dormakaba Group;66 Series: [www.stanleyhardwarefordoors.com/#sle](http://www.stanleyhardwarefordoors.com/#sle).

### B. Requirements:

1. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1.
2. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum.
3. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
4. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
5. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware.
6. Install hinges with fasteners supplied by manufacturer.
7. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

## 2.4 FLUSH BOLTS

### A. Manufacturers:

1. Ives, an Allegion brand: [www.allegion.com/us/#sle](http://www.allegion.com/us/#sle).
2. Rockwood: an Assa Abloy Group company; [www.assaabloydss.com](http://www.assaabloydss.com).

### B. Flush Bolts: Comply with BHMA A156.16, Grade 1.

1. Flush Bolt Throw: 3/4 inch (19 mm), minimum.
2. Provides extension bolts in leading edge of door, one bolt into floor, one bolt into top of frame.
  - a. Pairs of Swing Doors: At inactive leaves, provide flush bolts of type as required to comply with code.
3. Provide dustproof floor strike for bolt into floor, except at metal thresholds.
4. Manual Flush Bolts: Provide lever extensions for top bolt at over-sized doors.

## 2.5 MORTISE EXIT DEVICES

### A. Manufacturers:

1. Precision, dormakaba Group; 2000 Series: [www.precisionhardware.com/#sle](http://www.precisionhardware.com/#sle).
2. Von Duprin, an Allegion brand; 9875/9975 Series: [www.allegion.com/us/#sle](http://www.allegion.com/us/#sle).

### B. Exit Devices: Comply with BHMA A156.3, Grade 1.

1. Lever design to match lockset trim.

2. Provide cylinder with cylinder or hex-key dogging at non-fire-rated openings.
3. Provide exit devices properly sized for door width and height.
4. Provide strike as recommended by manufacturer for application indicated.
5. Provide UL (DIR) listed exit device assemblies for fire-rated doors and panic device assemblies for non-fire-rated doors.
6. For electrical options, provide quick connect plug-in pre-wired connectors.
7. Provide electrified options as scheduled.
8. Refer to "KEYING" article, herein.
9. Provide touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
10. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
11. Provide flush end caps for exit devices.
12. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
13. Where surface vertical rods are specified provide Rod Guards for all top rods and Rod with Extended Latch Guards for all bottom rods.
14. Mount mechanism case flush on face of doors or, provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
15. Top latch mounting: double- or single-tab mount for steel doors and face mount for aluminum doors eliminating requirement of tabs
16. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.
17. Provide multipoint lock at double doors without mullion.

## 2.6 LOCK CYLINDERS

### A. Manufacturers:

1. Best, dormakaba Group: [www.bestaccess.com/#sle](http://www.bestaccess.com/#sle).
2. Falcon: [www.allegion.com/us/#sle](http://www.allegion.com/us/#sle).
3. No Substitutions.

### B. Lock Cylinders: Provide key access on outside of each lock, unless otherwise indicated.

1. Provide small format interchangeable core (SFIC) and A2 system type cylinders, Grade 1, with seven-pin core in compliance with BHMA A156.5 at locations indicated.
2. Provide cylinders from same manufacturer as locking device.
3. Provide cams and/or tailpieces as required for locking devices.
4. Provide Keyway "Q".
5. Control Number:
  - a. Verify with owner.
6. Finish: Match existing.

## 2.7 MORTISE LOCKS

### A. Manufacturers:

1. Sargent; an Assa Abloy Group company; 8200/7800 Series: [www.assaabloydss.com/#sle](http://www.assaabloydss.com/#sle).
  2. Yale; 8800 Series: [www.assaabloydss.com/#sle](http://www.assaabloydss.com/#sle).
  3. Best, dormakaba Group; 40H: [www.bestaccess.com/#sle](http://www.bestaccess.com/#sle).
  4. Schlage, an Allegion brand; L400 or LM9300: [www.allegion.com/us/#sle](http://www.allegion.com/us/#sle).
  5. Falcon; MA500 Series: [www.allegion.com/us/#sle](http://www.allegion.com/us/#sle).
- B. Mortise Locks: Comply with BHMA A156.13, Series 1000, Operational Grade 1, Security Grade 2:
1. Latchbolt Throw: 3/4 inch (19 mm), minimum.
  2. Deadbolt Throw: 1 inch (25.4 mm), minimum.
  3. Backset: 2-3/4 inch (70 mm) unless otherwise indicated.
  4. Strikes: Provide manufacturer's standard strike for each latchset or lockset with strike box and curved lip extending to protect frame in compliance with indicated requirements.
    - a. Finish: Match existing.
    - b. Trim & Level Style: Match existing.
    - c. Provide privacy indicator where scheduled.
    - d. Provide deadbolt where scheduled.
    - e. Provide ANSI F13 anti-panic operation (inside lever simultaneously retracts deadbolt and latch).
    - f. Provide devices on double doors (astragals, latch protectors, etc) as required to maintain security and prevent tampering with latching hardware.

## 2.8 DOOR PULLS AND PUSH PLATES

- A. Door Pulls and Push Plates: Comply with BHMA A156.6.
1. Pull Type: Straight, unless otherwise indicated.
  2. Push Plate Type: Flat, with square corners, unless otherwise indicated.
    - a. Edges: Beveled, unless otherwise indicated.
  3. Material: Stainless steel, unless otherwise indicated.
  4. On solid doors, provide matching door pull and push plate on opposite faces.
  5. Provide push plates 4 inches (102 mm) wide by 16 inches (406 mm) high by 0.050 inch (1mm) thick.
  6. Provide pulls of solid bar stock.
  7. Provide pull plates 4 inches (102 mm) wide by 16 inches (406 mm) high by 0.050 inch (1 mm) thick and prepped for pull.

## 2.9 CLOSERS

- A. Manufacturers; Surface Mounted:
1. Stanley, DORMA USA, Inc; 8600 Series, 8900 Series, and TS93: [www.dorma.com/#sle](http://www.dorma.com/#sle).
  2. LCN, an Allegion brand; 4040XP Series: [www.allegion.com/us/#sle](http://www.allegion.com/us/#sle).
  3. Stanley, dormakaba Group; \_\_\_\_\_: [www.stanleyhardwarefordoors.com/#sle](http://www.stanleyhardwarefordoors.com/#sle).
- B. Closers: Comply with BHMA A156.4, Grade 1.



1. Type: Surface mounted to door.
  2. Provide door closer on each exterior door.
  3. Provide door closer on each fire-rated and smoke-rated door.
  4. Where an overlapping astragal is included on pairs of swinging doors, provide coordinator to ensure door leaves close in proper order.
  5. At corridor entry doors, mount closer on room side of door.
  6. At outswinging exterior doors, mount closer on interior side of door.
  7. Provide special templates, drop plates, mounting brackets, or adapters for arms and closers as required for details, overhead stops, and other door hardware items interfering with closer mounting.
- C. Closer Arms:
1. Plunger and Ball with T-handle or wings where hold open scheduled.

## 2.10 CONCEALED OVERHEAD STOPS

- A. Manufacturers:
1. Rixson or Sargent; an Assa Abloy Group company; 6 Series: [www.assaabloydss.com/#sle](http://www.assaabloydss.com/#sle).
  2. DORMA USA, Inc; 910 Series: [www.dorma.com/#sle](http://www.dorma.com/#sle).
  3. Glynn-Johnson, an Allegion brand; 450 Series: [www.allegion.com/us/#sle](http://www.allegion.com/us/#sle).
- B. Overhead Stops and Holders (Door Checks): Comply with BHMA A156.8, Grade 1.
1. Provide stop for every swinging door, unless otherwise indicated.
  2. Stop is not required if positive stop feature is specified for door closer; positive stop feature of door closer is not an acceptable substitute for a stop, unless otherwise indicated.
  3. Provide wall stops wherever possible in lieu of overhead stop.

## 2.11 PROTECTION PLATES

- A. Manufacturers:
1. Rockwood; an Assa Abloy Group company; K1050 Series: [www.assaabloydss.com/#sle](http://www.assaabloydss.com/#sle).
  2. Ives, an Allegion brand; 8400 Series: [www.allegion.com/us/#sle](http://www.allegion.com/us/#sle).
- B. Protection Plates: Comply with BHMA A156.6.
- C. Metal Properties: Stainless steel.
- D. Edges: Beveled, on four sides unless otherwise indicated.
- E. Fasteners: Countersunk screw fasteners.
- F. Drip Guard: Provide at head of all exterior doors.
1. Manufacturers:
    - a. Pemko; 346 Series: [www.pemko.com/#sle](http://www.pemko.com/#sle).
    - b. Reese; R201 Series: [www.reeseusa.com/#sle](http://www.reeseusa.com/#sle).
  2. Continuous surface mounted extruded aluminum.
  3. Finish to match storefront system.

## 2.12 KICK PLATES

- A. Kick Plates: Provide along bottom edge of push side of every door, except aluminum storefront entry doors, unless otherwise indicated.
  - 1. Size: 8 inch (203 mm) high by 2 inch (51 mm) less door width (LDW) on push side of door.

## 2.13 MOP PLATES

- A. Mop Plates: Provide along bottom edge of pull side of doors to provide protection from cleaning liquids and equipment damage to door surface.
  - 1. Size: 6 inch (152 mm) high by 1-1/2 inch (38 mm) less door width (LDW) on pull side and 2 inch (51 mm) LDW on push side of door.

## 2.14 ELECTROMAGNETIC DOOR HOLDERS

- A. Manufacturers:
  - 1. Rixson or Sargent; an Assa Abloy Group company; 1560 Series: [www.assaabloydss.com/#sle](http://www.assaabloydss.com/#sle).
  - 2. DORMA USA, Inc; EM Series: [www.dorma.com/#sle](http://www.dorma.com/#sle).
  - 3. LCN; SEM7800 Series: [www.us.allegion.com/#sle](http://www.us.allegion.com/#sle).
- B. Electromagnetic Door Holders: Comply with BHMA A156.15.
  - 1. Type: Wall mounted, single unit, standard duty, with strike plate attached to door.
  - 2. Holding Force, Standard Duty: 40 lbs-force (177 N), minimum.
  - 3. Voltage: 24 VDC, and provide power supplies by same manufacturer as holders.
  - 4. Provide interface with fire detectors and fire-alarm system for fire-rated door assemblies.

## 2.15 WALL STOPS

- A. Manufacturers:
  - 1. Rockwood; an Assa Abloy Group company; 409 Series: [www.assaabloydss.com/#sle](http://www.assaabloydss.com/#sle).
  - 2. Ives; WS406/407CCV Series: [www.us.allegion.com/#sle](http://www.us.allegion.com/#sle).
- B. Wall Stops: Comply with BHMA A156.16, Grade 1 and Resilient Material Retention Test as described in this standard.
  - 1. Provide wall stops to prevent damage to wall surface upon opening door.
  - 2. Type: Bumper, concave, wall stop.
  - 3. Material: Stainless steel housing with rubber insert.

## 2.16 ASTRAGALS

- A. Manufacturers:
  - 1. National Guard Products, Inc; 137N: [www.ngpinc.com/#sle](http://www.ngpinc.com/#sle).
  - 2. Zero International, Inc; 328 (pair): [www.zerointernational.com/#sle](http://www.zerointernational.com/#sle).
- B. Astragals: Comply with BHMA A156.22.
  - 1. Provide surface mounted astragal to cover or fill space for full door height between pair of doors or door and adjacent jamb.
  - 2. Type: Split, two parts, and with sealing gasket.

3. Material: Aluminum, with neoprene weatherstripping.
4. Provide non-corroding fasteners at exterior locations.
5. Exterior Doors: Steel, Z-shaped.

## 2.17 THRESHOLDS

### A. Manufacturers:

1. Pemko; an Assa Abloy Group company; 156A: [www.assaabloydss.com/#sle](http://www.assaabloydss.com/#sle).
2. National Guard Products, Inc; 2525: [www.ngpinc.com/#sle](http://www.ngpinc.com/#sle).
3. Zero International, Inc; 488S: [www.zerointernational.com/#sle](http://www.zerointernational.com/#sle).

### B. Thresholds: Comply with BHMA A156.21.

1. Provide threshold at each exterior door, unless otherwise indicated.
2. Type: Flat surface.
3. Material: Extruded Aluminum.
4. Size: 1/2 inch (13 mm) high, minimum of 5 inches (127 mm) deep, unless noted otherwise.
5. Threshold Surface: Fluted horizontal grooves across full width.
6. Field cut threshold to profile of frame and width of door sill for tight fit.
7. Provide non-corroding fasteners at exterior locations.

## 2.18 WEATHERSTRIPPING AND GASKETING

### A. Manufacturers:

1. National Guard Products, Inc: [www.ngpinc.com/#sle](http://www.ngpinc.com/#sle).
2. Reese Enterprises, Inc: [www.reeseusa.com/#sle](http://www.reeseusa.com/#sle).
3. Zero International, Inc: [www.zerointernational.com/#sle](http://www.zerointernational.com/#sle).

### B. Weatherstripping and Gasketing: Comply with BHMA A156.22.

#### 1. Manufacturers:

- a. National Guard Products, Inc; 700 Series: [www.ngpinc.com/#sle](http://www.ngpinc.com/#sle).
- b. Reese Enterprises, Inc; 655C: [www.reeseusa.com/#sle](http://www.reeseusa.com/#sle).
- c. Zero International, Inc; 429AA-S: [www.zerointernational.com/#sle](http://www.zerointernational.com/#sle).

2. Head and Jamb Type: Encased in retainer.Flat bar-Type.
3. Material: Aluminum, with silicone weatherstripping.
4. Provide gasketing for smoke and draft control doors that complies with local codes, requirements of assemblies tested in accordance with UL 1784.
5. Provide weatherstripping on each exterior door at head, jambs, and meeting stiles of door pairs, unless otherwise indicated; .

### C. Sweeps:

#### 1. Manufacturers:

- a. National Guard Products, Inc; 198NA or 101V: [www.ngpinc.com/#sle](http://www.ngpinc.com/#sle).
- b. Zero International, Inc; 539 or 8197: [www.zerointernational.com/#sle](http://www.zerointernational.com/#sle).

2. Door Sweep Type: Provide door shoe with drip cap for exterior applications.

3. Provide door bottom sweep on each exterior door, unless otherwise indicated.
4. Provide sweeps to completely seal the bottom of the door to the threshold and extend the seal partially across the face of the frame at the hinge and lock stiles.
5. Furnish with Neoprene insert which is easily replaceable and readily available.
6. Furnish with self-drilling TEK or sheet metal screws.
7. Provide gasketing for smoke and draft control doors that complies with local codes, requirements of assemblies tested in accordance with UL 1784.

#### 2.19 DOOR POSITION SWITCHES

- A. Manufacturers:
  1. Schlage Electronics
  2. GE-Interlogix
  3. Sargent
- B. Provide recessed type door position switches.
- C. Coordinate door and frame preparations with door and frame suppliers. If switches are being used with magnetic locking device, provide minimum of 4 inches (102 mm) between switch and magnetic locking device.

#### 2.20 COAT HOOKS

- A. Manufacturers:
  1. Rockwood; an Assa Abloy Group company; RM828: [www.assaabloydss.com/#sle](http://www.assaabloydss.com/#sle).
  2. Ives; 543: [www.us.allegion.com/#sle](http://www.us.allegion.com/#sle).
- B. Coat Hooks: Provide on room side of door, screw fastened.
- C. Material: Stainless steel.

#### 2.21 SILENCERS

- A. Silencers: Provide at equal locations on door frame to mute sound of door's impact upon closing.
  1. Single Door: Provide three on strike jamb of frame.
  2. Pair of Doors: Provide two on head of frame, one for each door at latch side.
  3. Material: Rubber, gray color.

#### 2.22 VERTICAL ROD COVERS

- A. Vertical Rod Covers: Provides protection from damage or tampering of surface mounted bottom vertical rod of exit device and to accommodate ADA Standards.
  1. Length: 12 inch (305 mm).
  2. Material: Stainless steel.

#### 2.23 KEY PAD

- A. Key Pad: Indoor or outdoor use, 12-key digital keypad to match existing and compatible with access control systems.
  1. Power: 24 VDC; 75mA Active and 16mA at Rest.
  2. Operating Temperature: Minus 22 to 158 degrees F (Minus 30 to 70 degrees C).

3. Finish: Match existing.

## 2.24 POWER SUPPLY

- A. Power Supply: Hard wired, with multiple zones providing eight (8) breakers for each output panel with individual control switches and LED's; UL (DIR) Class 2 listed.
  1. Provide power supplies approved by manufacturer of supplied electrified hardware.
  2. Provide appropriate quantity of power supplies necessary for proper operation of electrified locking components as recommended by manufacturer of electrified locking components with consideration for each electrified component using power supply, location of power supply, and approved wiring diagrams. Locate power supplies as directed by Architect.
  3. Power: regulated and filtered 24 VAC, 10 Amp; with 120 VAC power supply and UL class 2.
  4. Polarized connector for distribution boards.
  5. Fused primary input.
  6. AC input and DC output monitoring circuit w/LED indicators.
  7. Cover mounted AC Input indication.
  8. Tested and certified to meet UL294.
  9. NEMA 1 enclosure.
  10. Hinged cover w/lock down screws.
  11. Operating Temperature: 32 to 110 degrees F (0 to 43 degrees C).
  12. Provide with emergency release terminals that release devices upon activation of fire alarm system.

## 2.25 FINISHES

- A. Hinges at Exterior Doors: BHMA 630 (US32D) – Satin Stainless Steel
- B. Continuous Hinges: BHMA 628 (US28) – Clear Anodized Aluminum
- C. Power Transfers: BHMA 689 – Aluminum Powder Coat
- D. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D) – Satin Stainless Steel
- E. Coordinators & Mounting Brackets: BHMA 628 (US28) – Clear Anodized Aluminum
- F. Protection Plates: BHMA 630 (US32D) – Satin Stainless Steel
- G. Overhead Stops and Holders: BHMA 630 (US32D) – Satin Stainless Steel
- H. Door Closers: BHMA 689 (ALUM or LA) – Aluminum Powder Coat
- I. Wall Stops: BHMA 630 (US32D) – Satin Stainless Steel
- J. Weatherstripping: BHMA 628 (US28) – Clear Anodized Aluminum
- K. Thresholds: BHMA 719 (US27) – Mill Finish Aluminum
- L. Smoke Seal & Sound Seal: Black (BLK)
- M. Silencers: Gray (GRY)
- N. Door Position Switches: Black (BLK)
- O. Power Supplies: Gray (GRY)

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that doors and frames are ready to receive this work; labeled, fire-rated doors and frames are properly installed, and dimensions are as indicated on shop drawings.
- B. Verify that electric power is available to power operated devices and of correct characteristics.

### **3.2 INSTALLATION**

- A. Install hardware in accordance with manufacturer's instructions and applicable codes.
- B. Install hardware on fire-rated doors and frames in accordance with applicable codes and NFPA 80.
- C. Install hardware for smoke and draft control doors in accordance with NFPA 105.
- D. Use templates provided by hardware item manufacturer.
- E. Do not install surface mounted items until application of finishes to substrate are fully completed.
- F. Door Hardware Mounting Heights: Distance from finished floor to center line of hardware item. As indicated in following list; unless noted otherwise in Door Hardware Schedule or on drawings.
  - 1. Mounting heights in compliance with ADA Standards:
    - a. Locksets: 40-5/16 inch (1024 mm).
    - b. Push Plates/Pull Bars: 42 inch (1067 mm).
    - c. Deadlocks (Deadbolts): 48 inch (1219 mm).
    - d. Exit Devices: 40-5/16 inch (1024 mm).
    - e. Door Viewer: 43 inch (1092 mm); standard height 60 inch (1524 mm).
- G. Set exterior door thresholds with full-width bead of elastomeric sealant at each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.

### **3.3 FIELD QUALITY CONTROL**

- A. Hardware Supplier's Architectural Hardware Consultant shall field inspect and certify hardware and installation has been furnished and installed in accordance with manufacturer's instructions and as specified.

### **3.4 ADJUSTING**

- A. Adjust work under provisions of Section 01 70 00 - Execution and Closeout Requirements.
- B. Adjust hardware for smooth operation.
- C. Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.

### **3.5 CLEANING**

- A. Clean finished hardware in accordance with manufacturer's written instructions after final adjustments have been made.
- B. Clean adjacent surfaces soiled by hardware installation.

- C. Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.

**END OF SECTION**

SECTION 08 80 00  
GLAZING

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Glass and glazing materials and installation requirements are included in this section for other sections referencing this section.
- B. Insulating glass units.
- C. Glazing units.
- D. Glazing compounds and accessories.

1.2 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.
- B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015.
- C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- D. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2015).
- E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.
- G. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).
- H. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2015.
- I. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.
- J. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2010.
- K. GANA (GM) - GANA Glazing Manual; 2022.
- L. GANA (SM) - GANA Sealant Manual; 2008.
- M. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2023.
- N. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2023.
- O. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2023.

1.3 ADMINISTRATIVE REQUIREMENTS

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

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.



- B. Product Data on Glass: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
- C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.
- D. Samples: Submit two samples 12 by 12 inch (305 by 305 mm) in size of insulating glass units.
- E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

#### 1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA (GM) and GANA (SM) for glazing installation methods.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section.
- C. Installer Qualifications: Company specializing in performing work of the type specified.

#### 1.6 FIELD CONDITIONS

- A. Do not install glazing when ambient temperature is less than 40 degrees F (4 degrees C).
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

#### 1.7 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Insulating Glass Units: Provide a ten (10) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.

### **PART 2 PRODUCTS**

#### 2.1 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

- A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
  - 1. Design Pressure: Calculated in accordance with ASCE 7.
  - 2. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
  - 3. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
  - 4. Glass thicknesses listed are minimum.
- B. Vapor Retarder and Air Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure vapor retarder and air barrier.
  - 1. In conjunction with vapor retarder and joint sealer materials described in other sections.
    - a. Refer to Section 07 25 00.
  - 2. To utilize the inner pane of multiple pane insulating glass units for the continuity of the vapor retarder and air barrier seal.

3. To maintain a continuous vapor retarder and air barrier throughout the glazed assembly from glass pane to heel bead of glazing sealant.
- C. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
  2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
  3. Solar Optical Properties: Comply with NFRC 300 test method.

## 2.2 GLASS MATERIALS

- A. Float Glass: Provide float glass based glazing unless otherwise indicated.
1. Kind FT - Fully Tempered Type: Complies with ASTM C1048.
  2. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.

## 2.3 INSULATING GLASS UNITS

- A. Insulating Glass Units: Types as indicated.
1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
  2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
  3. Warm-Edge Spacers: Flexible silicone with polyisobutylene (PIB) primary seal.
    - a. Spacer Width: As required for specified insulating glass unit.
  4. Spacer Color: Black.
  5. Edge Seal:
    - a. Dual-Sealed System: Provide polyisobutylene sealant as primary seal applied between spacer and glass panes, and silicone, polysulfide, or polyurethane sealant as secondary seal applied around perimeter.
    - b. Color: Black.
  6. Purge interpane space with dry air, hermetically sealed.
- B. Type IG1 - Insulating Glass Units: Vision glass, double glazed, safety glazing.
1. Applications: Glazing adjacent to, and vision panels in doors.
  2. Space between lites filled with argon.
  3. Outboard Lite: Fully tempered float glass, 1/4 inch (6.4 mm) thick, minimum.
    - a. Tint: match existing.
  4. Inboard Lite: Fully tempered float glass, 1/4 inch (6.4 mm) thick, minimum.
    - a. Tint: Clear.
    - b. Coating: Low-E (passive type), on #3 surface.
  5. Total Thickness: 1 inch (25.4 mm).

6. Thermal Transmittance (U-Value), Winter - Center of Glass: 0.25, maximum.
  7. Visible Light Transmittance (VLT): 32 percent, minimum.
  8. Solar Heat Gain Coefficient (SHGC): 0.32, maximum.
  9. Markings for Safety Glazing Units: Provide permanent markings on each pane of safety glazing in compliance with ICC (IBC).
- C. Type IG2- Insulating Glass Units: Translucent glass, double glazed, glazing.
1. Applications: Exterior windows at latrine(s).
  2. Space between lites filled with argon.
  3. Outboard Lite: Annealed float glass, 1/4 inch (6.4 mm) thick, minimum.
  4. Coating: Translucent Low-E (passive type), on #3 surface.
  5. Laminated Inboard Lite: Annealed float glass, 1/8 inch (6.4 mm) thick, minimum.
    - a. Tint: Clear
  6. Interlayer: Polyvinyl butyal (PVB): 0.030 inch thick.
    - a. Product: Insulite Glass Company: translucent 65% white PVB, or an equivalent product approved in writing by Architect.
  7. Laminated Outboard Lite, Inner Pane: annealed float glass, 1/8 inch thick, minimum.
    - a. Tint: Clear.
  8. Total Thickness: 1 inch (25.4 mm).
  9. Thermal Transmittance (U-Value), Winter - Center of Glass: [0.25], maximum.

## 2.4 GLAZING UNITS

- A. Type G1 - Monolithic Safety Glazing: Non-fire-rated.
1. Applications:
    - a. Glazed lites in doors, except fire doors.
    - b. Glazed sidelights to doors.
    - c. Other locations required by applicable federal, state, and local codes and regulations.
  2. Glass Type: Fully tempered safety glass as specified.
  3. Tint: Clear.
  4. Thickness: 1/4 inch (6.4 mm), nominal.
  5. Markings for Safety Glazing Units: Provide permanent markings on safety glazing in compliance with ICC (IBC).

## 2.5 GLAZING COMPOUNDS

- A. Butyl Sealant: Single component; ASTM C920 Grade NS, Class 12-1/2, Uses M and A, Shore A hardness of 10 to 20; black color.
- B. Polysulfide Sealant: Two component; chemical curing, non-sagging type; ASTM C920 Type M, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; color as selected.

- C. Polyurethane Sealant: Single component, chemical curing, non-staining, non-bleeding; ASTM C920 Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 20 to 35; color as selected.
- D. Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; non-bleeding, non-staining; ASTM C920 Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; As selected color.
- E. Manufacturers:
  1. BASF Corporation: [www.basf.com/us/en.html/#sle](http://www.basf.com/us/en.html/#sle).
  2. Dow Corning Corporation: [www.dowcorning.com/construction/#sle](http://www.dowcorning.com/construction/#sle).
  3. Pecora Corporation: [www.pecora.com/#sle](http://www.pecora.com/#sle).
  4. Tremco Commercial Sealants & Waterproofing; Proglaze SSG: [www.tremcosealants.com/#sle](http://www.tremcosealants.com/#sle).
  5. Substitutions: See Section 01 60 00 - Product Requirements.

## 2.6 ACCESSORIES

- A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot (25 mm for each square meter) of glazing or minimum 4 inch (100 mm) by width of glazing rabbet space minus 1/16 inch (1.5 mm) by height to suit glazing method and pane weight and area.
- B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch (75 mm) long by one half the height of the glazing stop by thickness to suit application, self adhesive on one face.
- C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.
- D. Glazing Splines: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.

## PART 3 EXECUTION

### 3.1 VERIFICATION OF CONDITIONS

- A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.
- B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

### 3.2 PREPARATION

- A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

### 3.3 INSTALLATION, GENERAL

- A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.
- B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.
- C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.
- D. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.

### 3.4 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)

- A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.
- B. Place setting blocks at 1/4 points with edge block no more than 6 inch (152 mm) from corners.
- C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.
- D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

### 3.5 INSTALLATION - WET/DRY GLAZING METHOD (TAPE AND GASKET SPLINE GLAZING WITH CAP SEALANT)

- A. Application - Exterior Glazed: Set glazing infills from the exterior of the building.
- B. Cut glazing tape to length and set against permanent stops, 3/16 inch (5 mm) below sight line. Seal corners by butting tape and dabbing with butyl sealant.
- C. Place setting blocks at 1/4 points with edge block no more than 6 inch (152 mm) from corners.
- D. Rest glazing on setting blocks and push against fixed stop with sufficient pressure to attain full contact.
- E. Install removable stops without displacing glazing spline. Exert pressure for full continuous contact.
- F. Apply cap bead of silicone sealant along void between the stop and the glazing, to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

### 3.6 INSTALLATION - WET GLAZING METHOD (SEALANT AND SEALANT)

- A. Application - Exterior Glazed: Set glazing infills from the exterior of the building.
- B. Place setting blocks at 1/4 points and install glazing pane or unit.
- C. Install removable stops with glazing centered in space by inserting spacer shims both sides at 24 inch (610 mm) intervals, 1/4 inch (6.4 mm) below sight line.
- D. Fill gaps between glazing and stops with silicone type sealant to depth of bite on glazing, but not more than 3/8 inch (9 mm) below sight line to ensure full contact with glazing and continue the air and vapor seal.
- E. Apply sealant to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

### 3.7 INSTALLATION - WET/DRY GLAZING METHOD (PREFORMED TAPE AND SEALANT)

- A. Application - Exterior Glazed: Set glazing infills from the exterior of the building.

- B. Cut glazing tape to length and set against permanent stops, 3/16 inch (5 mm) below sight line. Seal corners by butting tape and dabbing with butyl sealant.
- C. Apply heel bead of butyl sealant along intersection of permanent stop with frame ensuring full perimeter seal between glass and frame to complete the continuity of the air and vapor seal.
- D. Place setting blocks at 1/4 points with edge block no more than 6 inch (152 mm) from corners.
- E. Rest glazing on setting blocks and push against tape and heel bead of sealant with sufficient pressure to attain full contact at perimeter of pane or glass unit.
- F. Install removable stops, with spacer strips inserted between glazing and applied stops 1/4 inch (6.4 mm) below sight lines.
  - 1. Place glazing tape on glazing pane of unit with tape flush with sight line.
- G. Fill gap between glazing and stop with silicone type sealant to depth equal to bite of frame on glazing, but not more than 3/8 inch (9 mm) below sight line.
- H. Apply cap bead of silicone type sealant along void between the stop and the glazing, to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

### 3.8 CLEANING

- A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.
- B. Remove non-permanent labels immediately after glazing installation is complete.
- C. Clean glass and adjacent surfaces after sealants are fully cured.
- D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

### 3.9 PROTECTION

- A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.
- B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

### 3.10 SCHEDULES

- A. Aluminum Window Glazing: Install glass using wet/dry glazing method (tape and gasket spline glazing with cap sealant), and with glass thickness as required to comply with performance requirements indicated in Section 08 5113.
- B. Aluminum-Framed Storefront Glazing: Install glass using dry method (gasket glazing), and with glass thickness as required to comply with performance requirements indicated in Section 08 43 13.
- C. Aluminum Entrance Window Glazing: Install glass using dry method (gasket glazing), and with glass thickness as required to comply with performance requirements indicated in Section 08 4313.
- D. Hollow Metal Steel Frames:
  - 1. Interior Glazing: Install glass using wet glazed method with paintable acrylic glazing sealant.

**END OF SECTION**

SECTION 08 83 00  
MIRRORS

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Glass mirrors.
  - 1. Tempered safety glass.
- B. Decorative mirrors.

1.2 REFERENCE STANDARDS

- A. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- B. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.
- C. ASTM C1036 - Standard Specification for Flat Glass; 2021.
- D. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.
- E. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).
- F. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2024.
- G. GANA (TIPS) - Mirrors: Handle with Extreme Care (Tips for the Professional on the Care and Handling of Mirrors); 2011.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data on Mirror Types: Submit structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
- C. Product Data on Glazing Compounds: Submit chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.
- D. Samples: Submit two samples, illustrating mirrors design, edging, coloration.
- E. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.4 FIELD CONDITIONS

- A. Do not install mirrors when ambient temperature is less than 50 degrees F (10 degrees C).
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.5 WARRANTY

- A. Provide five year manufacturer warranty for reflective coating on mirrors and replacement of same.

## **PART 2 PRODUCTS**

### **2.1 MATERIALS**

- A. Mirror Design Criteria: Select materials and/or provide supports as required to limit mirror material deflection to 1/200, or to the flexure limit of glass, with full recovery of glazing materials, whichever is less.
- B. Decorative Mirror Glass: Clear, annealed float glass; ASTM C1036.
  - 1. Thickness: 1/4 inch (6.4 mm).
  - 2. Edges: Flat ground.
  - 3. Finish: #1 quality polished, silver coated and hermetically sealed with an electrolytic copper plating.
  - 4. Meet ASTM-C-1036-91.
  - 5. Image quality: Excellent

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that openings for mirrored glazing are correctly sized and within tolerance.
- B. Verify that surfaces of mirror frames or recesses are clean, free of obstructions, and ready for installation of mirrors.

### **3.2 PREPARATION**

- A. Clean contact surfaces with solvent and wipe dry.
- B. Seal porous mirror frames or recesses with substrate compatible primer or sealer. Prime surfaces scheduled to receive sealant.

### **3.3 INSTALLATION**

- A. Install mirrors in accordance with manufacturer's recommendations.
- B. Set mirrors plumb and level, and free of optical distortion.
- C. Set mirrors with edge clearance free of surrounding construction including countertops or backsplashes.
- D. Frameless Mirrors: Set mirrors in proper place with adhesive, applied in accordance with adhesive manufacturer's instructions.

### **3.4 CLEANING**

- A. Remove wet glazing materials from finish surfaces.
- B. Remove labels after work is complete.
- C. Clean mirrors and adjacent surfaces.

**END OF SECTION**



SECTION 09 05 61  
COMMON WORK RESULTS FOR FLOORING PREPARATION

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. This section applies to floors identified in Contract Documents that are receiving the following types of floor coverings:
  - 1. Thin-set ceramic tile and stone tile.
- B. Removal of existing floor coverings.
- C. Preparation of new and existing concrete floor slabs for installation of floor coverings.
- D. Testing of concrete floor slabs for moisture and alkalinity (pH).
- E. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
  - 1. Contractor shall perform all specified remediation of concrete floor slabs. If such remediation is indicated by testing agency's report and is due to a condition not under Contractor's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.
- F. Patching compound.
- G. Remedial floor coatings.

1.2 REFERENCE STANDARDS

- A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens); 2016a.
- B. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters, and Gypsum Concrete; 2020.
- C. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.
- D. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

1.4 SUBMITTALS

- A. Visual Observation Report: For existing floor coverings to be removed.
- B. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
  - 1. Moisture and alkalinity (pH) limits and test methods.
  - 2. Manufacturer's required bond/compatibility test procedure.
- C. Remedial Materials Product Data: Manufacturer's published data on each product to be used for remediation.
  - 1. Manufacturer's qualification statement.

2. Manufacturer's statement of compatibility with types of flooring applied over remedial product.
  3. Test reports indicating compliance with specified performance requirements, performed by nationally recognized independent testing agency.
- D. Testing Agency's Report:
1. Description of areas tested; include floor plans and photographs if helpful.
  2. Summary of conditions encountered.
  3. Moisture and alkalinity (pH) test reports.
  4. Copies of specified test methods.
  5. Recommendations for remediation of unsatisfactory surfaces.
  6. Product data for recommended remedial coating.
  7. Submit report to Architect/Engineer.
  8. Submit report not more than two business days after conclusion of testing.
- E. Adhesive Bond and Compatibility Test Report.

#### 1.5 QUALITY ASSURANCE

- A. Moisture and alkalinity (pH) testing shall be performed by an independent testing agency employed and paid by Contractor.
- B. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.
- C. Contractor's Responsibility Relating to Independent Agency Testing:
1. Provide access for and cooperate with testing agency.
  2. Confirm date of start of testing at least 10 days prior to actual start.
  3. Allow at least 4 business days on site for testing agency activities.
  4. Achieve and maintain specified ambient conditions.
  5. Notify Architect/Engineer when specified ambient conditions have been achieved and when testing will start.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, handle, and protect products in accordance with manufacturer's instructions and recommendations.
- B. Deliver materials in manufacturer's packaging; include installation instructions.
- C. Keep materials from freezing.

#### 1.7 FIELD CONDITIONS

- A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F (18 degrees C) or more than 85 degrees F (30 degrees C).
- B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

## **PART 2 PRODUCTS**

### **2.1 MATERIALS**

- A. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:
  - 1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
  - 2. Latex or polyvinyl acetate additions are permitted; gypsum content is prohibited.
  - 3. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.
- B. Alternate Flooring Adhesive: Floor covering manufacturer's recommended product, suitable for the moisture and pH conditions present; low-VOC. In the absence of any recommendation from flooring manufacturer, provide a product recommended by adhesive manufacturer as suitable for substrate and floor covering and for conditions present.
- C. Remedial Floor Coating: Single- or multi-layer coating or coating/overlay combination intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.

## **PART 3 EXECUTION**

### **3.1 CONCRETE SLAB PREPARATION**

- A. Perform following operations in the order indicated:
  - 1. Existing concrete slabs (on-grade and elevated) with existing floor coverings:
    - a. Visual observation of existing floor covering, for adhesion, water damage, alkaline deposits, and other defects.
    - b. Removal of existing floor covering.
  - 2. Preliminary cleaning.
  - 3. Moisture vapor emission tests; 3 tests in the first 1000 square feet (100 square meters) and one test in each additional 1000 square feet (100 square meters), unless otherwise indicated or required by flooring manufacturer.
  - 4. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
  - 5. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
  - 6. Specified remediation, if required.
  - 7. Patching, smoothing, and leveling, as required.
  - 8. Other preparation specified.
  - 9. Adhesive bond and compatibility test.
  - 10. Protection.
- B. Remediations:

1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating or remedial sheet membrane over entire suspect floor area.
3. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

### 3.2 REMOVAL OF EXISTING FLOOR COVERINGS

- A. Comply with local, State, and federal regulations and recommendations of RFCI Recommended Work Practices for Removal of Resilient Floor Coverings, as applicable to floor covering being removed.
- B. Dispose of removed materials in accordance with local, State, and federal regulations and as specified.

### 3.3 PRELIMINARY CLEANING

- A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.
- B. Do not use solvents or other chemicals for cleaning.

### 3.4 MOISTURE VAPOR EMISSION TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F1869 and as follows.
- D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet (1.4 kg per 93 square meters) per 24 hours.
- F. Report: Report the information required by the test method.

### 3.5 INTERNAL RELATIVE HUMIDITY TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F2170 Procedure A and as follows.
- D. Testing with electrical impedance or resistance apparatus may not be substituted for the specified ASTM test method, as the values determined are not comparable to the ASTM test values and do not quantify the moisture content sufficiently.

- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if any test value exceeds 75 percent relative humidity.
- F. Report: Report the information required by the test method.

### 3.6 ALKALINITY TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

### 3.7 PREPARATION

- A. See individual floor covering section(s) for additional requirements.
- B. Comply with requirements and recommendations of floor covering manufacturer.
- C. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.
- D. Do not fill expansion joints, isolation joints, or other moving joints.

### 3.8 ADHESIVE BOND AND COMPATIBILITY TESTING

- A. Comply with requirements and recommendations of floor covering manufacturer.

### 3.9 APPLICATION OF REMEDIAL FLOOR COATING

- A. Comply with requirements and recommendations of coating manufacturer.

**END OF SECTION**

SECTION 09 21 16  
GYPSUM BOARD ASSEMBLIES

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Performance criteria for gypsum board assemblies.
- B. Metal stud wall framing.
- C. Metal channel ceiling framing.
- D. Gypsum wallboard.
- E. Joint treatment and accessories.
- F. Textured finish system.

1.2 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.
- B. Section 07 84 00 - Firestopping: Top-of-wall assemblies at fire-resistance-rated walls.

1.3 REFERENCE STANDARDS

- A. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing; 2020.
- B. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing; 2015, with Errata (2020).
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- D. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.
- E. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2020.
- F. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017.
- G. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2018.
- H. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2019b.
- I. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2018.
- J. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base; 2019.
- K. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.
- L. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
- M. GA-216 - Application and Finishing of Gypsum Panel Products; 2016.
- N. GA-214-2021 - Levels of Finish for Gypsum Panel Products.

#### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data:
  - 1. Provide data on metal framing, gypsum board, accessories, and joint finishing system.
  - 2. Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store gypsum products and accessories indoors and keep above freezing. Elevate boards above floor, on nonwicking supports, in accordance with manufacturer's recommendations.
- B. Store metal products to prevent corrosion.

### **PART 2 PRODUCTS**

#### 2.1 GYPSUM BOARD ASSEMBLIES

- A. Provide completed assemblies complying with ASTM C840 and GA-216.
  - 1. See PART 3 for finishing requirements.

#### 2.2 METAL FRAMING MATERIALS

- A. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S220 or equivalent.
- B. Nonstructural Framing System Components: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf (L/120 at 240 Pa).
  - 1. Studs: C-shaped with knurled or embossed faces.
  - 2. Runners: U shaped, sized to match studs.
  - 3. Ceiling Channels: C-shaped.
- C. Non-structural Framing Accessories:
  - 1. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
  - 2. Framing Connectors: ASTM A653/A653M G90 galvanized steel clips; secures cold rolled channel to wall studs for lateral bracing.

#### 2.3 BOARD MATERIALS

- A. Manufacturers - Gypsum-Based Board:
  - 1. American Gypsum Company: [www.americangypsum.com/#sle](http://www.americangypsum.com/#sle).
  - 2. CertainTeed Corporation: [www.certainteed.com/#sle](http://www.certainteed.com/#sle).
  - 3. Georgia-Pacific Gypsum: [www.gpgypsum.com/#sle](http://www.gpgypsum.com/#sle).
  - 4. USG Corporation: [www.usg.com/#sle](http://www.usg.com/#sle).
- B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
  - 1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
  - 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.

- a. Mold resistant board is required at all locations.
3. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
4. Thickness: 5/8 inch

## 2.4 GYPSUM BOARD ACCESSORIES

- A. Finishing Accessories: ASTM C1047, extruded aluminum alloy (6063 T5) or galvanized steel sheet ASTM A924/A924M G90, unless noted otherwise.
  1. Types: As detailed or required for finished appearance.
  2. Special Shapes: In addition to conventional corner bead and control joints, provide U-bead at exposed panel edges.
- B. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
  1. Fiberglass Tape: 2 inch (50 mm) wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
  2. Joint Compound: Setting type, field-mixed.
- C. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches (0.84 mm) in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.
- B. NOTE: All data cabling (including concealed or above ceilings) shall be protected from drywall mud or paint overspray or installed after drywall finishing and painting is completed. Paint or drywall mud on data cabling voids the cable manufacturer's warranty. Any data cabling with paint or drywall on them shall be replaced by the contractor at no additional cost to the Owner.

### 3.2 FRAMING INSTALLATION

- A. Metal Framing: Install in accordance with ASTM C1007/AISI S220 and manufacturer's instructions.
- B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
  1. Level ceiling system to a tolerance of 1/1200.
  2. Laterally brace entire suspension system.
  3. Install bracing as required at exterior locations to resist wind uplift.
- C. Studs: Space studs at 16 inches on center (at 406 mm on center).
  1. Extend partition framing to structure where indicated and to ceiling in other locations.
  2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
- D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.



- E. Resilient Sound Isolation Clips: Install resilient sound isolation clips, and where applicable, associated furring sections and channels, in accordance with clip manufacturer's written instructions.

### 3.3 BOARD INSTALLATION

- A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Single-Layer Nonrated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
- C. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- D. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of nonrated double-layer assemblies, which may be installed by means of adhesive lamination.

### 3.4 INSTALLATION OF TRIM AND ACCESSORIES

- A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
  - 1. Not more than 30 feet (10 meters) apart on walls and ceilings over 50 feet (16 meters) long.
  - 2. Space control joints in accordance with ASTM C840 at specific locations indicated on drawings or approved by Architect.
- B. Corner Beads: Install at external corners, using longest practical lengths.
- C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

### 3.5 JOINT TREATMENT

- A. Glass Mat Faced Gypsum Board and Exterior Glass Mat Faced Sheathing: Use fiberglass joint tape, embed and finish with setting type joint compound.
- B. Paper Faced Gypsum Board: Use paper joint tape, embed with drying type joint compound and finish with drying type joint compound.
- C. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
  - 1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
  - 2. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.
- D. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
  - 1. Feather coats of joint compound so that camber is maximum 1/32 inch (0.8 mm).

### 3.6 TEXTURE FINISH

- A. Apply per GA-214, Level 4 finish with light orange peel texture for walls to receive paint.

### 3.7 TOLERANCES

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet (3 mm in 3 m) in any direction.

3.8 PROTECTION

- A. Protect installed gypsum board assemblies from subsequent construction operations.

**END OF SECTION**

SECTION 09 30 00  
TILING

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Tile for floor applications.
- B. Tile for wall applications.
- C. Ceramic trim.
- D. Non-ceramic trim.

1.2 RELATED REQUIREMENTS

- A. Section 09 21 16 - Gypsum Board Assemblies: Tile backer board.

1.3 REFERENCE STANDARDS

- A. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2017.
- B. ANSI A108.1b - Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set, Modified Dry-Set, or Improved Modified Dry-Set Cement Mortar; 2023.
- C. ANSI A108.1c - Contractor's Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set, Modified Dry-Set, or Improved Modified Dry-Set Cement Mortar; 2023.
- D. ANSI A108.2 - American National Standard General Requirements: Materials, Environmental and Workmanship; 2019.
- E. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesive or Water Cleanable Tile-Setting Epoxy Adhesive; 2023.
- F. ANSI A108.5 - Setting of Ceramic Tile with Dry-Set Cement Mortar, Modified Dry-Set Cement Mortar, EGP (Exterior Glue Plywood) Modified Dry-Set Cement Mortar, or Improved Modified Dry-Set Cement Mortar; 2023.
- G. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grout Epoxy; 2023.
- H. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout; 1999 (Reaffirmed 2019).
- I. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; 2023.
- J. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 2017 (Reaffirmed 2022).
- K. ANSI A108.12 - Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Modified Dry-Set Mortar; 2023.
- L. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2005 (Reaffirmed 2016).

- M. ANSI A108.19 - American National Standard Specifications for Interior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs by the Thin-Bed Method Bonded with Modified Dry-Set Cement Mortar or Improved Modified Dry-Set Cement Mortar; 2017.
- N. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar; 2012 (Revised).
- O. ANSI A118.7 - American National Standard Specifications for High Performance Cement Grouts for Tile Installation; 2010 (Reaffirmed 2016).
- P. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes For Thin-Set Ceramic Tile And Dimension Stone Installation; 2014.
- Q. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2022.
- R. ASTM C373 - Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products; 2018.
- S. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2024.

#### 1.4 SUBMITTALS

- A. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
- B. Verification Samples: Of grout and 12 x 12 inches in size minimum illustrating pattern, color variations of tile.
- C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. Extra Tile: 1 percent of each size, color, and surface finish combination, but not less than 1 box of each type.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

#### 1.6 FIELD CONDITIONS

- A. Do not install solvent-based products in an unventilated environment.
- B. Maintain ambient and substrate temperature above 50 degrees F (10 degrees C) and below 100 degrees F (38 degrees C) during installation and curing of setting materials.

## PART 2 PRODUCTS

### 2.1 TILE

- A. Porcelain Mosaic Tile, Type T1: ANSI A137.1 standard grade. Colored body porcelain tile.
  - 1. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.
  - 2. Size: 2 by 2 inch (51 by 51 mm), nominal.
  - 3. Surface Finish: Matte.
  - 4. Color(s): As indicated on drawings.
  - 5. Mounted Sheet Size: 11 3/4 by 11 3/4 inches (30 by 30 mm).
- B. Porcelain Tile, Type T2: ANSI A137.1 standard grade. Colored body porcelain tile.
  - 1. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.

2. Size: 12 by 24 inch (30 by 60 mm), nominal.
  3. Thickness: 9 mm.
  4. Surface Finish: Matte.
  5. Color(s): As indicated on drawings.
- C. Porcelain Tile, Type T3: ANSI A137.1 standard grade.Colored body porcelain tile.
1. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.
  2. Size: 12 by 24 inch (30 by 60 mm), nominal.
  3. Thickness: 9 mm.
  4. Surface Finish: Matte.
  5. Color(s): As indicated on drawings.
- D. Porcelain Tile, Type T4: ANSI A137.1 standard grade.Colored body porcelain tile.
1. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.
  2. Size: 8 x 24 inch, nominal.
  3. Thickness: 8 mm.
  4. Edges: Rectified.
  5. Surface Finish: Honed.
  6. Color(s): As indicated on drawings.

## 2.2 TRIM AND ACCESSORIES

- A. Non-Ceramic Trim: Satin natural anodized extruded aluminum, style and dimensions to suit application, for setting using tile mortar or adhesive.
1. Applications:
    - a. Open edges of wall tile.
      - 1) Basis of Design: Schluter-Jolly
    - b. Wall corners, outside.
      - 1) Basis of Design: Schluter-Jolly
    - c. Transition between floor finishes of different heights.
      - 1) Basis of Design: Schluter - Schiene
    - d. Floor to wall joints.
      - 1) Basis of Design: Schluter - Dilex AHKA
  2. Manufacturers:
    - a. Schluter-Systems: [www.schluter.com/#sle](http://www.schluter.com/#sle).
    - b. Substitutions: See Section 01 60 00 - Product Requirements.

## 2.3 SETTING MATERIALS

- A. Latex-Portland Cement Mortar Bond Coat: ANSI A118.4.

## 2.4 GROUTS

- A. High Performance Polymer Modified Grout: ANSI A118.7 polymer modified cement grout.

1. Applications: Use this type of grout where indicated and where no other type of grout is indicated.
2. Use sanded grout for joints 1/8 inch (3.2 mm) wide and larger; use unsanded grout for joints less than 1/8 inch (3.2 mm) wide.
3. Color(s): As selected by Architect/Engineer from manufacturer's full line.

## 2.5 ACCESSORY MATERIALS

- A. Waterproofing Membrane at showers: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
  1. Fluid or Trowel Applied Type:
    - a. Thickness: 25 mils (0.6 mm), minimum, dry film thickness.
    - b. Products:
      - 1) LATICRETE International, Inc; LATICRETE HYDRO BAN: [www.laticrete.com/#sle](http://www.laticrete.com/#sle).
      - 2) Merkrete, by Parex USA, Inc; Merkrete Hydro Guard 2000: [www.merkrete.com/#sle](http://www.merkrete.com/#sle).
      - 3) USG Corporation; Durock Brand Liquid Waterproofing Membrane: [www.usg.com/#sle](http://www.usg.com/#sle).
      - 4) Substitutions: See Section 01 60 00 - Product Requirements.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.
- C. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of setting materials to sub-floor surfaces.

### 3.2 PREPARATION

- A. Protect surrounding work from damage.
- B. Vacuum clean surfaces and damp clean.
- C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.

### 3.3 INSTALLATION - GENERAL

- A. Install tile and thresholds and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.19, manufacturer's instructions, and TCNA (HB) recommendations.
- B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
- C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.

- D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
- E. Install tile with 1/8 inch joints unless otherwise indicated.
- F. Use joint spacers, in size indicated above, for individual tiles and between sheets of sheet-mounted mosaic tiles.
- G. Form internal angles square and external angles bullnosed.
- H. Install non-ceramic trim in accordance with manufacturer's instructions.
- I. Sound tile after setting. Replace hollow sounding units.
- J. Keep control and expansion joints free of mortar, grout, and adhesive.
- K. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
- L. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.
- M. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

### 3.4 INSTALLATION - FLOORS - THIN-SET METHODS

- A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F113, dry-set or latex-Portland cement bond coat, with standard grout, unless otherwise indicated.
  - 1. Where waterproofing membrane is indicated, install in accordance with TCNA (HB) Method F122, with latex-Portland cement grout.

### 3.5 INSTALLATION - SHOWERS AND BATHTUB WALLS

- A. At shower walls install in accordance with TCNA (HB) Method B412, over cementitious backer units with waterproofing membrane.
- B. Grout with standard grout as specified above.

### 3.6 INSTALLATION - WALL TILE

- A. On exterior walls install in accordance with TCNA (HB) Method W244, thin-set over cementitious backer units, with waterproofing membrane.
- B. Over cementitious backer units on studs, install in accordance with TCNA (HB) Method W244, using membrane at toilet rooms.
- C. Over interior concrete and masonry install in accordance with TCNA (HB) Method W202, thin-set with dry-set or latex-Portland cement bond coat.

### 3.7 CLEANING

- A. Clean tile and grout surfaces.

### 3.8 PROTECTION

- A. Do not permit traffic over finished floor surface for 4 days after installation.

**END OF SECTION**

SECTION 09 51 00  
ACOUSTICAL CEILINGS

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical units.

1.2 REFERENCE STANDARDS

- A. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2022.
- B. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2013.
- C. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2017.
- D. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2023.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Do not install acoustical units until after interior wet work is dry.

1.4 SUBMITTALS

- A. Product Data: Provide data on suspension system components and acoustical units.
- B. Verification Samples: Submit two samples 4 X 4 inch minimum in size illustrating material and finish of acoustical units.

1.5 FIELD CONDITIONS

- A. Maintain uniform temperature of minimum 60 degrees F (16 degrees C), and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

**PART 2 PRODUCTS**

2.1 ACOUSTICAL UNITS

- A. Acoustical Panels, Type ACP1: Mineral fiber with membrane-faced overlay, with the following characteristics:
  - 1. Classification: ASTM E1264 Type IV.
    - a. Form: 2, water felted.
    - b. Pattern: "E" - lightly textured.
  - 2. Size: 24 by 24 inches (610 by 610 mm).
  - 3. Thickness: 1 inch.



4. Light Reflectance: 85 percent, determined in accordance with ASTM E1264.
  5. NRC Range: .85 to 1.0, determined in accordance with ASTM E1264.
  6. Articulation Class (AC): 170, determined in accordance with ASTM E1264.
  7. Ceiling Attenuation Class (CAC): 35, determined in accordance with ASTM E1264.
  8. Panel Edge: Tegular.
  9. Color: White.
  10. Suspension System: Exposed grid.
  11. Products:
    - a. Armstrong World Industries, Inc; Calla: [www.armstrongceilings.com/#sle](http://www.armstrongceilings.com/#sle).
    - b. USG Corporation; Mars Acoustical Panels: [www.usg.com/ceilings/#sle](http://www.usg.com/ceilings/#sle).
- B. Acoustical Panels, Type ACP2: Mineral fiber with membrane-faced overlay, with the following characteristics:
1. Basis of Design; Model 973 Lumawash by Armstrong Ceilings
  2. Classification: ASTM E1264 Type IV.
  3. Size: 24 by 24 inches (610 by 610 mm).
  4. Thickness: 5/8 inch (16 mm).
  5. Disinfectability: wipe, spray, and fog.
  6. Sag / Humidity Resistance: Superior rating
  7. Mold Resistance: Superior rating
  8. Panel Edge: Square.
  9. Suspension System Type: Exposed grid.

## 2.2 SUSPENSION SYSTEM(S)

- A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.
- B. Exposed Suspension System: Hot-dipped galvanized steel grid with steel cap.
1. Structural Classification: Intermediate-duty, when tested in accordance with ASTM C635/C635M.
  2. Profile: Tee; 15/16 inch (24 mm) face width.
  3. Finish: Baked enamel.
  4. Color: White.
  5. Products:
    - a. USG Corporation; Donn Brand ZXLA 15/16 inch Acoustical Suspension System: [www.usg.com/ceilings/#sle](http://www.usg.com/ceilings/#sle).
    - b. Armstrong World Industries, Inc; Prelude XL: [www.armstrongceilings.com](http://www.armstrongceilings.com).

## 2.3 ACCESSORIES

- A. Hanger Wire: 12 gauge, 0.08 inch (2 mm) galvanized steel wire.
- B. Hold-Down Clips: Manufacturer's standard clips to suit application.

- C. Perimeter Moldings: Same metal and finish as grid.
- D. Touch-up Paint: Type and color to match acoustical and grid units.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.

#### **3.2 INSTALLATION - SUSPENSION SYSTEM**

- A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.
- B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- C. Locate system on room axis according to reflected plan.
- D. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
  - 1. Use longest practical lengths.
- E. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- F. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- H. Support fixture loads using supplementary hangers located within 6 inches (152 mm) of each corner, or support components independently.
- I. Do not eccentrically load system or induce rotation of runners.

#### **3.3 INSTALLATION - ACOUSTICAL UNITS**

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Fit border trim neatly against abutting surfaces.
- D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- E. Cutting Acoustical Units:
  - 1. Cut to fit irregular grid and perimeter edge trim.
  - 2. Make field cut edges of same profile as factory edges.
- F. Where round obstructions occur, provide preformed closures to match perimeter molding.
- G. Install hold-down clips where indicated on drawings on each panel to retain panels tight to grid system; comply with fire rating requirements.

### 3.4 TOLERANCES

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet (3 mm in 3 m).
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

**END OF SECTION**

SECTION 09 65 00  
RESILIENT FLOORING

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Resilient tile flooring.
- B. Resilient base.
- C. Installation accessories.

1.2 REFERENCE STANDARDS

- A. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile; 2023.
- B. ASTM F1700 - Standard Specification for Solid Vinyl Floor Tile; 2020.
- C. ASTM F1861 - Standard Specification for Resilient Wall Base; 2021.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Verification Samples: Submit two samples, 6 x 6 inch minimum in size, illustrating color and pattern for each resilient flooring product specified.
- D. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
  - 2. Extra Flooring Material: 1 box of each type and color.
  - 3. Extra Wall Base: 20 lineal feet of each type and color.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
- B. Store all materials off of the floor in an acclimatized, weather-tight space.
- C. Maintain temperature in storage area between 55 degrees F (13 degrees C) and 90 degrees F (72 degrees C).
- D. Do not double stack pallets.

1.5 FIELD CONDITIONS

- A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F (21 degrees C) to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F (13 degrees C).

## **PART 2 PRODUCTS**

### **2.1 TILE FLOORING**

- A. Vinyl Composition Tile - Type VCT: Homogeneous, with color extending throughout thickness.
  - 1. Manufacturers:
    - a. Johnsonite, a Tarkett Company: [www.johnsonite.com/#sle](http://www.johnsonite.com/#sle).
    - b. Substitutions: See Section 01 60 00 - Product Requirements.
  - 2. Minimum Requirements: Comply with ASTM F1066, of Class corresponding to type specified.
  - 3. Size: 12 by 12 inch (305 by 305 mm).
  - 4. Thickness: 0.125 inch (3.2 mm).
  - 5. Color: To be selected by Architect/Engineer from manufacturer's full range.
- B. Vinyl Tile - Type LVT1: Printed film type, with transparent or translucent wear layer and commercial grade backing.
  - 1. Minimum Requirements: Comply with ASTM F1700, Class III.
  - 2. Plank Tile Size: 4.9 by 39.3 inch (125 by 100 mm).
  - 3. Wear Layer Thickness: 22 mil.
  - 4. Total Thickness: 3.0 mm.
  - 5. Tile Edge: Straight.
  - 6. Color: As indicated on drawings.
  - 7. Install: Full glue down, per manufacture's recommendations.

### **2.2 RESILIENT BASE**

- A. Resilient Base - Type B1: ASTM F1861, Type TS, rubber, vulcanized thermoset; style as scheduled.
  - 1. Height: 4 inches (100 mm).
  - 2. Thickness: 0.125 inch (3.2 mm).
  - 3. Finish: Satin.
  - 4. Length: Roll.
  - 5. Color: As indicated on drawings.

### **2.3 ACCESSORIES**

- A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
- B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.
- C. Moldings, Transition and Edge Strips: Same material as flooring.
- D. Sealer and Wax: Types recommended by flooring manufacturer.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.
- C. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
  - 1. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

### **3.2 PREPARATION**

- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- B. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.
- C. Prohibit traffic until filler is fully cured.
- D. Clean substrate.
- E. Apply primer as required to prevent "bleed-through" or interference with adhesion by substances that cannot be removed.

### **3.3 INSTALLATION - GENERAL**

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install in accordance with manufacturer's written instructions.

### **3.4 INSTALLATION - TILE FLOORING**

- A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.
- B. Factory sealer: New floors shall be stripped and resealed with one coat of manufacturer recommended base. Install minimum (5) coats of manufacturer recommended commercial quality floor polish. Buff floor to glossy finish.

### **3.5 INSTALLATION - RESILIENT BASE**

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches (45 mm) between joints.
- B. Miter internal corners. At external corners, 'V' cut back of base strip to 2/3 of its thickness and fold. At exposed ends, use premolded units.
- C. Install base on solid backing. Bond tightly to wall and floor surfaces.
- D. Scribe and fit to door frames and other interruptions.

### **3.6 CLEANING**

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's written instructions.

3.7 PROTECTION

- A. Prohibit traffic on resilient flooring for 48 hours after installation.

**END OF SECTION**

SECTION 09 91 23  
INTERIOR PAINTING

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints.
- C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
  - 1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
  - 2. Mechanical and Electrical:
    - a. In finished areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
    - b. In finished areas, paint shop-primed items.
- D. Do Not Paint or Finish the Following Items:
  - 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
  - 2. Items indicated to receive other finishes.
  - 3. Items indicated to remain unfinished.
  - 4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
  - 5. Stainless steel, anodized aluminum, bronze, terne coated stainless steel, and lead items.
  - 6. Floors, unless specifically indicated.
  - 7. Brick, architectural concrete, cast stone, integrally colored plaster and stucco.
  - 8. Glass.
  - 9. Concrete masonry units in utility, mechanical, and electrical spaces.
  - 10. Concealed pipes, ducts, and conduits.

1.2 DEFINITIONS

- A. Comply with ASTM D16 for interpretation of terms used in this section.

1.3 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2016.
- C. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2016.



- D. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; Current Edition.
- E. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.
- F. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).
- G. SSPC-SP 6 - Commercial Blast Cleaning; 2007.

#### 1.4 SUBMITTALS

- A. Product Data: Provide complete list of products to be used, with the following information for each:
  - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
  - 2. MPI product number (e.g. MPI #47).
  - 3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
  - 4. If proposal of substitutions is allowed under submittal procedures, explanation of substitutions proposed.
- B. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches (216 by 279 mm) in size, illustrating range of colors available for each finishing product specified.
  - 1. Where sheen is specified, submit samples in only that sheen.
  - 2. Allow 30 days for approval process, after receipt of complete samples by Architect/Engineer.
- C. Certification: By manufacturer that paints and finishes comply with VOC limits specified.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Product Requirements for additional provisions.
  - 2. Label each container with color in addition to the manufacturer's label.

#### 1.5 MOCK-UP

- A. Contractor shall provide mock-up on site of each specified interior wall/door/trim color for Owner acceptance. mock-up shall be portable, and easily moved into any room for Owner acceptance.
- B. Locate where directed by Architect.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

#### 1.7 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Provide lighting level of 80 ft candles (860 lx) measured mid-height at substrate surface.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Provide paints and finishes from the same manufacturer to the greatest extent possible.
  - 1. In the event that a single manufacturer cannot provide specified products, minor exceptions will be permitted provided approval by Architect/Engineer is obtained using the specified procedures for substitutions.
  - 2. Substitution of other products by the same manufacturer is preferred over substitution of products by a different manufacturer.
  - 3. Substitution of a different paint system using MPI-approved products by the same manufacturer will be considered.
- B. Paints:
  - 1. Base Manufacturer: Sherwin-Williams Company: [www.sherwin-williams.com](http://www.sherwin-williams.com).
  - 2. Diamond Vogel Paints: [www.diamondvogel.com](http://www.diamondvogel.com).
  - 3. PPG Paints: [www.ppgpaints.com](http://www.ppgpaints.com).
  - 4. Sherwin-Williams Company: [www.sherwin-williams.com](http://www.sherwin-williams.com).

### **2.2 PAINTS AND FINISHES - GENERAL**

- A. Paints and Finishes: Ready mixed, unless intended to be a field-catalyzed paint.
  - 1. Where MPI paint numbers are specified, provide products listed in Master Painters Institute Approved Product List, current edition available at [www.paintinfo.com](http://www.paintinfo.com), for specified MPI categories, except as otherwise indicated.
  - 2. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
  - 3. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
  - 4. Supply each paint material in quantity required to complete entire project's work from a single production run.
  - 5. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
- B. Volatile Organic Compound (VOC) Content:
  - 1. Provide paints and finishes that comply with the most stringent requirements specified in the following:
    - a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
    - b. Architectural coatings VOC limits of State in which the project is located.

2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
- C. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect/Engineer from the manufacturer's full line.
- D. Colors: As indicated on drawings.
  1. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling they are mounted on/under.

### 2.3 PAINT SYSTEMS - INTERIOR

- A. Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board, concrete, concrete masonry units, brick, wood, plaster, uncoated steel, shop primed steel, galvanized steel, and aluminum.
  1. Paint hollow metal doors and door frames in all spaces indicated to receive new finishes.
  2. Two top coats and one coat primer.
  3. Primer: As recommended by top coat manufacturer for specific substrate.

### 2.4 PRIMERS

- A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.

### 2.5 ACCESSORY MATERIALS

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Do not begin application of paints and finishes until substrates have been properly prepared.
- B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.
- D. Test shop-applied primer for compatibility with subsequent cover materials.
- E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
  1. Gypsum Wallboard: 12 percent.
  2. Plaster and Stucco: 12 percent.
  3. Masonry, Concrete, and Concrete Masonry Units: 12 percent.
  4. Interior Wood: 15 percent, measured in accordance with ASTM D4442.

### 3.2 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- F. Concrete:
  - 1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
- G. Masonry:
  - 1. Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
- H. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.
- I. Plaster: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
- J. Aluminum: Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
- K. Galvanized Surfaces:
  - 1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
- L. Ferrous Metal:
  - 1. Solvent clean according to SSPC-SP 1.
  - 2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
  - 3. Remove rust, loose mill scale, and other foreign substances using using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.
- M. Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.
- N. All existing miscellaneous anchoring components (nails, screws, expansion anchors, hangers, etc.) shall be removed by Contractor from existing exposed surfaces. All existing or new holes, voids, cracks or otherwise damaged wall surfaces shall be patched and repaired to match existing surfaces prior to application of new finishes.

### 3.3 APPLICATION

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

- B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- D. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
- E. Sand wood and metal surfaces lightly between coats to achieve required finish.
- F. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- G. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

#### 3.4 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

#### 3.5 PROTECTION

- A. Touch-up damaged finishes after Substantial Completion.

**END OF SECTION**

SECTION 09 96 00  
HIGH-PERFORMANCE COATINGS

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. High performance coatings.
- B. Surface preparation.

1.2 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide complete list of all products to be used, with the following information for each:
  - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
  - 2. MPI product number (e.g. MPI #47).
  - 3. Cross-reference to specified coating system(s) product is to be used in; include description of each system.
  - 4. If proposal of substitutions is allowed under submittal procedures, explanation of all substitutions proposed.
- C. Samples: Submit two samples 8 by 8 inch (203 by 203 mm) in size illustrating colors available for selection.
- D. Maintenance Data: Include cleaning procedures and repair and patching techniques.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of coating, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Coating Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.4 FIELD CONDITIONS

- A. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- B. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the coating product manufacturer.
- C. Do not install materials when temperature is below 55 degrees F (13 degrees C) or above 90 degrees F (32 degrees C).
- D. Maintain this temperature range, 24 hours before, during, and 72 hours after installation of coating.
- E. Provide lighting level of 80 ft candles (860 lx) measured mid-height at substrate surface.
- F. Restrict traffic from area where coating is being applied or is curing.

## PART 2 PRODUCTS

### 2.1 HIGH-PERFORMANCE COATINGS

- A. For urethane coatings, provide systems that meet the following minimum performance criteria, unless more stringent criteria are specified:
1. Abrasion Resistance: No more than 116 mg loss after 1,000 cycles, when tested in accordance with ASTM D 4060, (CS-17 Wheel, 1,000 gram load).
  2. Impact Resistance: No cracking or delamination of film after 32 inch-pounds (3.6 J) direct impact, when tested in accordance with ASTM D 2794.
  3. Adhesion: Minimum rating 5B, when tested in accordance with ASTM D 3359, (Method B, 5mm Crosshatch).
  4. Gloss and Color Retention: No blistering, cracking, chalking or delamination of film. No less than 71% gloss retention, no more than 0.07 DEHunter color change (white) and 26 units gloss loss after 500 MJ UV exposure (TR6062), when tested in accordance with ASTM D 4141 Method C (EMMAQUA).

### 2.2 TOP COAT MATERIALS

- A. Coatings - General: Provide complete multi-coat systems formulated and recommended by manufacturer for the applications indicated, in the thicknesses indicated; number of coats specified does not include primer or filler coat.
- B. Urethane Coating for exterior ferrous metal (including galvanized, primed, and bare), not indicated to receive another finish:
1. Number of Coats: Two.
  2. Product Characteristics:
    - a. Percentage of solids by volume: 71, minimum.
    - b. Dry film thickness, per coat: 2.5 mils, minimum.
  3. Top Coat(s): Polyurethane, Two-Component; aliphatic moisture-curing polyurethane.
    - a. Sheen: Semi-Gloss.
    - b. Products:
      - 1) Tnemec Company, Inc; Series 1095 Endura-Shield II: [www.tnemec.com/#sle](http://www.tnemec.com/#sle).
      - 2) Substitutions: Section 01 60 00 - Product Requirements.
  4. Primer: As recommended by coating manufacturer for specific substrate.
- C. Fluoropolymer Coating for roof-top equipment screens and supports:
1. Number of Coats: Two.
  2. Product Characteristics:
    - a. Percentage of solids by volume, 71 = percent, minimum.
    - b. Dry film thickness, per coat, 2.0 mils, minimum.
  3. Top Coat(s): Air Dry Fluoropolymer, Two Component.
    - a. Sheen: semi-gloss.

- b. Products:
  - 1) PPG Paints; Coraflon ADS: [www.ppgpaints.com](http://www.ppgpaints.com).
  - 2) Tnemec Company, Inc; Series 1071V Fluoronar: [www.tnemec.com](http://www.tnemec.com).
  - 3) Substitutions: Section 01 60 00 - Product Requirements.
- 4. Primer: As recommended by coating manufacturer for specific substrate.
- D. Shellac: Pure, white type.

### 2.3 ACCESSORY MATERIALS

- A. Accessory Materials: Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of coated surfaces.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Do not begin application of coatings until substrates have been properly prepared.
- C. Verify that substrate surfaces are ready to receive work as instructed by the coating manufacturer. Obtain and follow manufacturer's instructions for examination and testing of substrates.
- D. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- E. Test shop-applied primer for compatibility with subsequent cover materials.
- F. Proceed with coating application only after unacceptable conditions have been corrected.
  - 1. Commencing coating application constitutes Contractor's acceptance of substrates and conditions.

### 3.2 PREPARATION

- A. Clean surfaces of loose foreign matter.
- B. Remove substances that would bleed through finished coatings. If unremovable, seal surface with shellac.
- C. Remove finish hardware, fixture covers, and accessories and store.
- D. Ferrous Metal:
  - 1. Solvent clean according to SSPC-SP 1.
  - 2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
  - 3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning", and protect from corrosion until coated.
- E. Protect adjacent surfaces and materials not receiving coating from spatter and overspray; mask if necessary to provide adequate protection. Repair damage.



### 3.3 PRIMING

- A. Apply primer to all surfaces, unless specifically not required by coating manufacturer. Apply in accordance with coating manufacturer's instructions.

### 3.4 COATING APPLICATION

- A. Apply coatings in accordance with manufacturer's written instructions, to thicknesses specified.
- B. Apply in uniform thickness coats, without runs, drips, pinholes, brush marks, or variations in color, texture, or finish. Finish edges, crevices, corners, and other changes in dimension with full coating thickness.

### 3.5 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.
- B. Clean surfaces immediately of overspray, splatter, and excess material.
- C. After coating has cured, clean and replace finish hardware, fixtures, and fittings previously removed.

### 3.6 PROTECTION

- A. Protect finished work from damage.

**END OF SECTION**

SECTION 10 14 00  
SIGNAGE

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Room signs.
- B. Door Number Signs

1.2 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
- C. Shop Drawings: Show fabrication and installation details for signs.
  - 1. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
  - 2. Provide message list, typestyles, graphic elements, including tactile characters and Braille, and layout for each sign.
- D. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
- E. Selection Samples: Where colors are not specified, submit two sets of color selection charts or chips.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Package signs as required to prevent damage before installation.
- B. Store tape adhesive at normal room temperature.

1.5 FIELD CONDITIONS

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.

**PART 2 PRODUCTS**

2.1 SIGNAGE APPLICATIONS

- A. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.

B. Door Number Signs: Type A

1. Locations: Provide at all pedestrian doors.
2. Material: Laminated acrylic plastic
3. Sign Type: Flat signs with engraved panel media as specified.
4. Sign Height: 1 1/2 inches
5. Sign Width: 6 inches
6. Character Height: 1" engraved.
7. Text: Arial
8. Text Copy: Match door numbers on door schedule.
9. Face Color: As selected by architect from manufacturer's full line.
10. Mounting: double-face VHB tape.
11. Mount on door head frame on exterior side of interior doors and interior side of exterior doors.

C. Room Signs: Type B.

1. Locations: Restrooms, Exits, Mechanical
2. Sign Type: Flat signs with engraved panel media as specified.
3. Material: Laminated acrylic plastic
4. Provide "tactile" signage, with letters raised minimum 1/32 inch (0.8 mm) and Grade II braille.
5. Character Height: 1 inch (25 mm).
6. Text: Arial
7. Sign Height: 9 1/2" in
8. Sign Width: 6 1/2" inch
9. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers to be determined later, and braille.
10. Mounting: double-face VHB tape.

D. Room Signs: Type C.

1. Locations: All other rooms
2. Sign Type: Flat signs with engraved panel media as specified. Provide 2 1/4 inch high clear "window" across bottom of sign to receive interchangeable paper inserts for room name. Provide Microsoft Word template for use in creating future inserts for 1 or 2 rows of 3/4" high text.
3. Material: Laminated acrylic plastic
4. Provide "tactile" signage, with letters raised minimum 1/32 inch (0.8 mm) and Grade II braille.
5. Character Height: 1 inch (25 mm).
6. Text: Arial
7. Sign Height: 8 1/2" inch
8. Sign Width: 8 1/2" inch
9. Mounting: double-face VHB tape.

## 2.2 SIGN TYPES

- A. Flat Signs: Signage media without frame.
  - 1. Edges: Square.
  - 2. Corners: 1/4 inch Radiused.

## 2.3 TACTILE SIGNAGE MEDIA

- A. Injection Molded Panels: One-piece acrylic plastic, with raised letters and braille.
  - 1. Total Thickness: 1/8 inch (3 mm).

## 2.4 NON-TACTILE SIGNAGE MEDIA

- A. Silk Screened Plastic Panels: Letters and graphics silk screened onto reverse side of plastic surface.

## **PART 3 EXECUTION**

### 3.1 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.

### 3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install neatly, with horizontal edges level.
- C. Locate signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.
- D. Protect from damage until Substantial Completion; repair or replace damage items.

**END OF SECTION**

SECTION 10 21 13.19  
PLASTIC TOILET COMPARTMENTS

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Solid plastic toilet compartments.
- B. Urinal and vestibule screens.

1.2 RELATED REQUIREMENTS

- A. Section 10 28 00 - Toilet, Bath, and Laundry Accessories.

1.3 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- B. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2024.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on panel construction, hardware, and accessories.
- C. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.
- D. Samples: Submit two samples of partition panels, 2 x 2 inch in size illustrating panel finish, color, and sheen.

**PART 2 PRODUCTS**

2.1 MANUFACTURERS

- A. Solid Plastic Toilet Compartments:
  - 1. Scranton Products; Hiny Hiders Partitions: [www.scrantonproducts.com/#sle](http://www.scrantonproducts.com/#sle).
  - 2. Substitutions: Section 01 60 00 - Product Requirements.

2.2 HDPE PLASTIC TOILET COMPARTMENTS

- A. Solid Plastic Toilet Compartments: Factory fabricated doors, pilasters, and divider panels made of solid molded high density polyethylene (HDPE), tested in accordance with NFPA 286 , tested in accordance with NFPA 286; floor-mounted headrail-braced including the urinal screens.
- B. Provide stainless-steel heat-sink strips applied to the bottom edge of panels and doors.

- C. Doors:
  1. Thickness: 1 inch (25 mm).
  2. Width: 24 inch (610 mm).
  3. Width for Handicapped Use: 36 inch (915 mm), out-swinging.
  4. Height: 55 inch (1397 mm).
- D. Panels:
  1. Thickness: 1 inch (25 mm).
  2. Height: 55 inch (1397 mm).
  3. Depth: As indicated on drawings.
- E. Pilasters:
  1. Thickness: 1 inch (25 mm).
  2. Width: As required to fit space; minimum 3 inch (76 mm).
- F. Screens: Without doors; to match compartments; mounted to wall with two panel brackets with vertical support/bracing same as compartments Floor mounted and overhead braced..

### 2.3 ACCESSORIES

- A. Pilaster Shoes: Stainless steel, satin finish, 3 inches (76 mm) high; concealing floor fastenings.
  1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.
- B. Head Rails: Extruded aluminum, anti-grip profile.
  1. Size: Manufacturer's standard size.
- C. Wall and Pilaster Brackets: Stainless steel; manufacturer's standard type for conditions indicated on drawings.
- D. Attachments, Screws, and Bolts: Stainless steel , tamper proof type.
- E. Hinges: Anodized aluminum, manufacturer's standard finish.
  1. Continuous-type hinge, self closing.
- F. Door Hardware: Stainless steel, manufacturer's standard finish.
  1. Door Latch: Slide type with exterior emergency access feature. Provide occupancy indicator.
  2. Door Strike and Keeper with Rubber Bumper: Mount on pilaster in alignment with door latch.
  3. Provide door pull for out-swinging doors.
- G. Coat Hook: One per compartment, mounted on door.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify correct spacing of and between plumbing fixtures.
- C. Verify correct location of built-in framing, anchorage, and bracing.

### 3.2 INSTALLATION

- A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.
- B. Maintain 3/8 inch to 1/2 inch (9 mm to 13 mm) space between wall and panels and between wall and end pilasters.
- C. Attach panel brackets securely to walls using anchor devices.
- D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.

### 3.3 TOLERANCES

- A. Maximum Variation From True Position: 1/4 inch (6 mm).
- B. Maximum Variation From Plumb: 1/8 inch (3 mm).

### 3.4 ADJUSTING

- A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch (5 mm).
- B. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.
- C. Adjust adjacent components for consistency of line or plane.

**END OF SECTION**

SECTION 10 28 00  
TOILET, BATH, AND LAUNDRY ACCESSORIES

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Commercial toilet accessories.
- B. Commercial shower and bath accessories.
- C. Electric hand/hair dryers.

1.2 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- D. ASTM B456 - Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium; 2017 (Reapproved 2022).
- E. ASTM C1036 - Standard Specification for Flat Glass; 2021.
- F. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2024.
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- H. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.
- C. Operation and Maintenance Data: Provide manufacturer's operation and maintenance instructions for electric hand/hair dryers.

**PART 2 PRODUCTS**

2.1 MATERIALS

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
  - 1. Grind welded joints smooth.
- B. Stainless Steel Sheet: ASTM A666, Type 304.
- C. Galvanized Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.
- D. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.



## 2.2 FINISHES

- A. Stainless Steel: Satin finish, unless otherwise noted.
- B. Chrome/Nickel Plating: ASTM B456, SC 2, polished finish, unless otherwise noted.

## 2.3 COMMERCIAL TOILET ACCESSORIES

- A. Toilet Paper Dispenser:
  - 1. Georgia Pacific: Compact Quad 4-Roll Coreless High-Capacity Toilet Paper Dispenser, Black
  - 2. Dimensions: 6.9 inch long, 11.75 inch wide, 13.25 inch high
- B. Paper Towel Dispenser: Automated touchless unit to accept 10" x 800' towel rolls.
  - 1. Basis of Design: Georgia Pacific; EnMotion 10" Recessed Automated Touchless Paper Towel Dispenser, Model 59466A by Georgia Pacific, or equal.
  - 2. Cover: Stainless steel.
  - 3. Paper Discharge: Touchless automatic.
  - 4. Mounting: Semi recessed.
  - 5. Power: AC power adapter.
- C. Soap Dispenser:
  - 1. Basis of Design: Spartan Chemical; Lite'N Foamy Dispenser-White. Model: 975600
- D. Mirrors: Stainless steel framed, 1/4 inch (6 mm) thick annealed float glass; ASTM C1036.
  - 1. Annealed Float Glass: Silvering, protective and physical characteristics in compliance with ASTM C1503.
  - 2. Size: 24 x 60 inches.
  - 3. Frame: 0.05 inch (1.3 mm) angle shapes, with mitered and welded and ground corners, and tamperproof hanging system; satin finish.
  - 4. Backing: Full-mirror sized, minimum 0.03 inch (0.8 mm) galvanized steel sheet and nonabsorptive filler material.
  - 5. Products:
    - a. Bobrick Washroom Equipment, Inc: [www.bobrick.com](http://www.bobrick.com).
    - b. Bradley Corporation; [www.bradleycorp.com/#sle](http://www.bradleycorp.com/#sle).
    - c. Substitutions: Section 01 60 00 - Product Requirements.
- E. Grab Bars: Stainless steel, smooth surface.
  - 1. Standard Duty Grab Bars:
    - a. Push/Pull Point Load: 250 pound-force (1112 N), minimum.
    - b. Dimensions: 1-1/4 inch (32 mm) outside diameter, minimum 0.05 inch (1.3 mm) wall thickness, exposed flange mounting, 1-1/2 inch (38 mm) clearance between wall and inside of grab bar.
    - c. Finish: Satin.
    - d. Length and Configuration: As indicated on drawings.

- e. Products:
  - 1) Bobrick Washroom Equipment, Inc: [www.bobrick.com](http://www.bobrick.com).
  - 2) Bradley Corporation; [www.bradleycorp.com/#sle](http://www.bradleycorp.com/#sle).
  - 3) Substitutions: Section 01 60 00 - Product Requirements.
- F. Sanitary Napkin Disposal Unit: Stainless steel, back-to-back partition mounting with adjustable flanges, self-closing door, locking bottom panel with full-length stainless steel piano-type hinge, removable receptacle.
  - 1. Products:
    - a. Bobrick Washroom Equipment, Inc; Model B-354: [www.bobrick.com](http://www.bobrick.com).
    - b. Bradley Corporation; Model 4721-15: [www.bradleycorp.com/#sle](http://www.bradleycorp.com/#sle).
    - c. Substitutions: Section 01 60 00 - Product Requirements.

## 2.4 COMMERCIAL SHOWER AND BATH ACCESSORIES

- A. Shower Curtain Rod: Stainless steel tube, 1 inch (25 mm) outside diameter, 0.04 inch (1.0 mm) wall thickness, satin-finished, with 3 inch (75 mm) outside diameter, minimum 0.04 inch (1.0 mm) thick satin-finished stainless steel flanges, for installation with exposed fasteners.
- B. Shower Curtain:
  - 1. Material: Opaque vinyl, 0.008 inch (0.2 mm) thick, matte finish, with antibacterial treatment, flameproof and stain-resistant.
  - 2. Grommets: Stainless steel; pierced through top hem on 6 inch (150 mm) centers.
  - 3. Color: White.
  - 4. Shower Curtain Hooks: Chrome-plated or stainless steel spring wire designed for snap closure.
- C. Folding Shower Seat: Wall-mounted surface; welded tubular seat frame, structural support members, swing-down legs, hinges, and mechanical fasteners of Type 304 stainless steel, L-shaped, right hand seat.
  - 1. Seat: Phenolic or polymeric composite one-piece seat or seat slats, of color as selected.
  - 2. Size: ADA Standards compliant.
  - 3. Products:
    - a. Seachrome Corporation; Accessibility Seats, L-Shaped Transfer with Swing-down Legs, Reversible: [www.seachrome.com/#sle](http://www.seachrome.com/#sle).
    - b. Bobrick Washroom Equipment, Inc: [www.bobrick.com](http://www.bobrick.com).
    - c. Bradley Corporation: [www.bradleycorp.com/#sle](http://www.bradleycorp.com/#sle).
    - d. Substitutions: Section 01 60 00 - Product Requirements.
- D. Wall-Mounted Soap Dish: Heavy duty, seamless stainless steel, surface-mounted with drain holes, without grab bar, satin finish; with concealed mechanical fastening suitable for substrate and backplate.
  - 1. Products:
    - a. Gamco USA; Model MSA-5: [www.gamcousa.com](http://www.gamcousa.com).
    - b. Substitutions: Section 01 60 00 - Product Requirements.

## 2.5 ELECTRIC HAND/HAIR DRYERS

### A. Electric Hand Dryers:

1. Operation: Automatic, sensor-operated on and off.
2. Mounting: Wall-mounted - surface.
3. Cover: Stainless steel with brushed finish.
  - a. Tamper-resistant screw attachment of cover to mounting plate.
4. Depth: 4 inches or less to meet ADA requirements
5. Input Voltage: Low voltage 100-120V
6. Airspeed: 420 mph at low voltage
7. Products:
  - a. Basis of Design: Dyson; Airblade V: [www.dyson.com](http://www.dyson.com)
8. Air Velocity: 18,000 linear feet per minute (91 m/s), minimum, at full power.
9. Heater: 500 W, minimum, at full power.
10. Sound level: 80 db max.
11. Exit Air Temperature: 113 deg. F min.
12. Automatic shut-off after 60 seconds of continuous use.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.
- C. For electrically-operated accessories, verify that electrical power connections are ready and in the correct locations.

### 3.2 INSTALLATION

- A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.
- B. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.

### 3.3 PROTECTION

- A. Protect installed accessories from damage due to subsequent construction operations.

**END OF SECTION**

SECTION 10 44 00  
FIRE PROTECTION SPECIALTIES

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Fire extinguishers.
- B. Indoor Steel fire extinguisher cabinets.
- C. Exterior polystyrene fire extinguisher cabinets.

1.2 REFERENCE STANDARDS

- A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).
- B. NFPA 10 - Standard for Portable Fire Extinguishers; 2017, with Errata (2018).

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide extinguisher operational features.
- C. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.

**PART 2 PRODUCTS**

2.1 MANUFACTURERS

- A. Fire Extinguishers:
  - 1. Amerex Model B456
  - 2. Substitutions: Not allowed.
- B. Steel Interior Fire Extinguisher Cabinets and Accessories:
  - 1. Activar Construction Products Group - JL Industries: [www.activarcpg.com](http://www.activarcpg.com).
  - 2. Larsen's Manufacturing Co: [www.larsensmfg.com](http://www.larsensmfg.com).
  - 3. Nystrom, Inc: [www.nystrom.com](http://www.nystrom.com).
  - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Polystyrene Exterior Fire Extinguisher Cabinets and Accessories:
  - 1. Activar Construction Products Group - JL Industries: [www.activarcpg.com](http://www.activarcpg.com).
  - 2. Substitutions: See Section 01 60 00 - Product Requirements.

## 2.2 FIRE EXTINGUISHERS

- A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
- B. Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gage.
  - 1. Class: A:B:C.
  - 2. Size: 10 pound (4.54 kg).
  - 3. Finish: Baked polyester powder coat, color as selected.
  - 4. Temperature range: -40 degrees F (-40 degrees C) to 120 degrees F (49 degrees C).

## 2.3 STEEL INTERIOR FIRE EXTINGUISHER CABINETS

- A. Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire resistance rating of walls where being installed.
- B. Cabinet Construction: Fire rated.
  - 1. Formed primed steel sheet; 0.036 inch (0.9 mm) thick base metal.
- C. Fire Rated Cabinet Construction: One-hour fire rated.
  - 1. Steel; double wall or outer and inner boxes with 5/8 inch (15.9 mm) thick fire barrier material.
- D. Cabinet Configuration: 3" Semi-recessed type.
  - 1. Sized to accommodate accessories.
- E. Door: 0.036 inch (0.9 mm) thick, reinforced for flatness and rigidity; latch. Hinge doors for 180 degree opening with two butt hinge. Provide nylon catch.
- F. Door Glazing: Plastic, clear, 1/8 inch (3 mm) thick acrylic. Set in resilient channel gasket glazing. Provide full-vision panel.
- G. Cabinet Mounting Hardware: Appropriate to cabinet. Pre-drill for anchors.
- H. Weld, fill, and grind components smooth.
- I. Finish of Cabinet Exterior Trim and Door: Baked enamel, white color.
- J. Finish of Cabinet Interior: White enamel.
- K. Provide red vertical FE letters.

## 2.4 POLYSTYRENE EXTERIOR FIRE EXTINGUISHER CABINETS

- A. Cabinet Construction: Injection molded high impact crystal polystyrene, .110 thickness with ultra-violet inhibitors for UV resistance.
- B. Cabinet Configuration: Surface mounted to rooftop equipment.
  - 1. Coordinate with rooftop equipment manufacturer to prevent voiding any manufacturer's warranties.
- C. Finish of Cabinet: red.
- D. Cover material: .100 high impact crystal polystyrene with Pull handle located at the bottom and etched "PULL" lettering.
- E. Cover color: Red.
- F. Decals: UV resistant "FIRE".
- G. Size: Sized to accommodate accessories.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

### **3.2 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install cabinets plumb and level.
- C. Secure rigidly in place.
- D. Place extinguishers and accessories in cabinets.

**END OF SECTION**

SECTION 10 51 13  
METAL LOCKERS

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Metal lockers.
- B. Locker benches.

1.2 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's published data on locker construction, sizes, and accessories.
- C. Shop Drawings: Indicate locker plan layout, numbering plan and combination lock code.
- D. Samples: Submit two samples 2 by 2 inch in size showing color and finish of metal locker material.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect locker finish and adjacent surfaces from damage.

**PART 2 PRODUCTS**

2.1 MANUFACTURERS

- A. Metal Lockers:
  - 1. ASI Storage Solutions; \_\_\_\_\_: [www.asi-storage.com/#sle](http://www.asi-storage.com/#sle).
  - 2. Lyon Workspace Products; \_\_\_\_\_: [www.lyonworkspace.com/#sle](http://www.lyonworkspace.com/#sle).
  - 3. Republic Storage Systems Co; \_\_\_\_\_: [www.republicstorage.com/#sle](http://www.republicstorage.com/#sle).
  - 4. Spacesaver Corporation; Day Use Lockers: [www.spacesaver.com/#sle](http://www.spacesaver.com/#sle).
  - 5. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 LOCKER APPLICATIONS

- A. Metal Lockers: free-standing with matching closed base.
  - 1. Width: 18 inches (457 mm).
  - 2. Depth: 18 inches (457 mm).
  - 3. Height: 72 inches (1830 mm).
  - 4. Configuration: Single tier.

5. Fittings: Size and configuration as indicated on drawings.
    - a. Upper shelf.
    - b. Hooks: One: top mounted double prong; Two: Side mounted hook (on each side).
  6. Ventilation: Perforated front panels.
  7. Locking: Padlock hasps, for padlocks provided by Owner.
  8. Provide sloped top.
  9. Color: To be selected from manufacturer's full range by Architect/Engineer.
- B. ADA Metal lockers, free-standing with matching closed base.
1. Width: 18 inches (457 mm).
  2. Depth: 18 inches (457 mm).
  3. Height: 72 inches (1830 mm).
  4. Fittings: Size and configuration as indicated on drawings. Shelves and hooks to meet ADA guidelines
    - a. Upper shelf.
    - b. Hooks: Two: Side mounted hook (on each side)
  5. Ventilation: Perforated front panels
  6. Locking: Padlock hasps, for padlocks provided by Owner.
  7. 4 inch square ADA sticker to indicate accessible locker

## 2.3 METAL LOCKERS

- A. Accessibility: Design units indicated on drawings as 'accessible' to comply with ICC A117.1 and ADA Standards.
- B. Locker Case Construction:
  1. Heavy-Duty, Welded Construction: Made of formed and welded together galvanized steel; metal edges finished smooth without burrs; baked enamel or powder coat finished inside and out.
    - a. Assembly: Do not use bolts, screws, or rivets to assemble locker bodies.
    - b. Locker Body Components: Formed and flanged from steel sheet of the following type and minimum thicknesses:
      - 1) Body and Shelves: 16 gauge, 0.0598 inch (1.52 mm).
      - 2) Backs: 18 gauge, 0.0478 inch (1.21 mm).
      - 3) Base: 18 gauge, 0.0478 inch (1.21 mm).
        - (a) Height: 4 inches (100 mm).
- C. Sloped Top: 20 gauge, 0.0359 inch (0.91 mm), with closed ends.
- D. Coat Hooks: Stainless steel or zinc-plated steel.
- E. Number Plates: Provide oval shaped aluminum plates. Form numbers of block font style with ADA designation, in contrasting color.
- F. Locks: Locker manufacturer's standard type indicated in Applications article above.



## 2.4 ADA LOCKER BENCHES

- A. Locker Benches: Stationary type; bench top of laminated birch; painted steel pedestals. Floor mounted.
  - 1. Height: 18 inches.
  - 2. Length: 42 inch.
  - 3. Depth: 24 inch.
  - 4. Bench Finish:
    - a. Pedestals: 304 Stainless steel pedestal.
    - b. Bench Top: Manufacture's standard hardwood finish with two-coat clear catalyzed lacquer top/sides.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Place and secure on prepared base.
- C. Install lockers plumb and square.
- D. Install fittings if not factory installed.
- E. Replace components that do not operate smoothly.

### 3.2 CLEANING

- A. Clean locker interiors and exterior surfaces.

**END OF SECTION**

SECTION 22 05 00  
COMMON WORK RESULTS FOR PLUMBING

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. The work shall include the furnishings of systems, equipment and materials specified in this Division and as called for on the Plumbing Drawings to include supervision, quality control, operation, methods and labor for the fabrication, installation, start-up and tests for the complete plumbing installation. The work shall also include the furnishing of necessary hoisting facilities to set materials and equipment in place and the furnishing of any scaffolding and transportation associated with this work.
- B. Examine the project site and become familiar with existing conditions which will affect the work. Review the drawings and specifications of other trades and take note of conditions to be created which will affect the work. All conditions shall be considered in the preparation of bids; no additional compensation will be made on the behalf of this Contractor.
- C. Provide labor necessary to demolish the existing plumbing systems as shown on the drawings, as described in Part 3.1, Existing Conditions, or as required.
- D. Where noted on the drawings or where called for in other sections of the specification, the Contractor for this division shall install equipment furnished by others, and shall make required service connections. Verify with the supplier of the equipment the requirements for the installation. This contractor shall be responsible for the removal and installation of railings, piping, ductwork, louvers, etc. as required to install new equipment.

1.2 DAMAGE

- A. The Contractor shall be responsible for damage to the work of other trades, or to the building and its contents, caused by equipment installation.

1.3 PERMITS AND INSPECTIONS

- A. Obtain and furnish necessary permits and inspection certificates for material and labor furnished. Permits and certificates shall be obtained from the proper inspection authorities. The cost of permits, certificates and fees required in connection with the installation shall be borne by the Contractor, unless otherwise noted in the detailed contractual description preceding these specifications. Where applications are required for the procuring of utility services to the building, see that such application is properly filed with the utility, and that information required for such an application is presented to the extent and in the form required by the utility company.

1.4 CODES AND STANDARDS

- A. Standards listed by reference, including revisions by issuing authority, form a part of this specification section to the extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.
- B. Applicable provisions of the following codes and standards are hereby imposed on a general basis for the mechanical work in addition to specific applications specified by individual work sections of these specifications.
  - 1. ANSI/ASHRAE/IES 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings

2. IECC - International Energy Conservation Code
  3. ANSI Pressure Piping Standards (B31)
  4. AGA - American Gas Association
  5. IFGC - International Fuel Gas Code
  6. IFC - International Fire Code
  7. IBC - International Building Code
  8. AWS Standards for Welding
  9. NFPA/NEC 70 - National Electrical Code
  10. Local and/or State Plumbing, Mechanical and Building Codes
  11. Occupational Safety and Health Act (OSHA)
  12. Uniform Plumbing Code
  13. International Mechanical Code
  14. NFPA Codes and Standards
- C. Any product used for dispensing potable water shall meet NSF 61 and NSF 372 testing standards. Third party testing shall be required.
- D. If any work indicated on the drawings or specified herein conflicts in any way with any of the rules and regulations of the above Authorities, the Contractor shall promptly notify the Architect/Engineer in writing and do so no less than 72 hours before bids are opened. In the event the Contractor fails to notify the Architect/Engineer and changes are required by said conflicts, the Contractor shall make such changes as are required without additional cost to this Owner.
- E. Installations must be safe in every respect and must not create a condition which will be harmful to building occupants; to operating, installing or testing personnel; to workmen; or to the public. The contractor for each installation shall be solely responsible for providing installations which will meet these conditions. If the Contractor believes that the installation will not be safe for all parties, report these beliefs in writing to the Architect/Engineer before any equipment is purchased or work is installed, giving recommendations. The Architect/Engineer will work out required changes and adjustments in contract price where adjustments are warranted.

## 1.5 DRAWINGS

- A. A complete set of current up-to-date Project Drawings and Specifications shall be kept on the site at all times. Prior to installing any of the work, check the drawings for dimensions and see that the work does not interfere with clearance required for ceilings, beams, foundations, finished columns, pilasters, partitions and electrical equipment as shown on the drawings and details. After work is installed and it develops that interferences occur which have not been called to the Architect/Engineer's attention before the installation, the Contractor shall, at his own expense, make such changes in his work as directed by the Architect/Engineer.
- B. The contract drawings for plumbing work are in part diagrammatic, intended to convey the scope of work and indicate general arrangement and approximate sizes and locations of equipment and materials. Where job conditions require reasonable changes in indicated locations and arrangement, the Contractor shall make such changes as directed by the Architect/Engineer, without additional cost to the Owner.

- C. Because of the scale of the drawings, certain basic items such as pipe fittings, access panels, and sleeves may not be shown; but where such items are required by other sections of these specifications or where they are required by the nature of the work, they shall be furnished and installed. Rough-in dimensions and locations shall be verified with the supplier of equipment furnished by other trades, or by the Owner, prior to the time of roughing-in.
- D. Equipment specification may not deal individually with minute items required such as components, parts, controls and devices which may be required to produce the equipment performance specified, or as required to meet the equipment warranties. Where such items are required, they shall be included by the supplier of the equipment, whether or not specifically called for.
- E. The drawings and the specifications are cooperative and supplementary. It is the intent of both said drawings and specifications to cover all mechanical requirements in their entirety as nearly as possible. The Contractor shall closely check the drawings and specifications for any obvious errors or omissions and bring any such condition to the attention of the Architect/Engineer prior to the receipt of bids, in order to permit clarification by means of a mailed Addendum. If there is no question prior to the bid proposal date, the Architect/Engineer shall assume that the drawings and specifications are complete and correct and will expect the intent of said documents to be complied with, and the installation to be complete in all respects, according to said intent.
- F. Locate equipment which must be serviced, operated or maintained in fully accessible positions. Minor deviations from the contract drawings may be made to allow for better accessibility, but changes of magnitude, or which involve extra cost, shall not be made without prior approval. Ample space shall be allowed for removal of parts that may require replacement or service in the future.
- G. All valves, pumps, etc. shall be accessible for maintenance purposes. Locate items carefully and coordinate with other trades so that each valve and piece of equipment is accessible and functional. Items located above a non-accessible ceiling, chase, or soffit shall be accessible through an access door. Coordinate location of access doors with the general contractor.

## 1.6 RESPONSIBILITY

- A. The Contractor's responsibility shall not end with the installation and connecting of the various apparatus. It shall include the services of an experienced superintendent, who shall be constantly in charge of the work, together with the qualified journeymen, helpers and laborers required to properly unload, install, connect, adjust, start, operate and test the work involved, including equipment and materials furnished by other trades or by the Owner, until such time as the entire plumbing installation functions properly in every detail.

## 1.7 COORDINATION

- A. Coordinate the work with other trades prior to installation.
- B. No piping or equipment, which is foreign to the electrical equipment, or architectural appurtenances shall be run over the top of any electrical panels or electrical equipment, in accordance with NEC 110.26. This does not prohibit sprinkler protection for the installation.
- C. The determination of quantities of material and equipment required shall be made from the drawings. Schedules on the drawings and in the specifications are completed as an aid, but where discrepancies arise, it shall be the Contractor's responsibility to provide the required quantity.
- D. Where the specifications state that equipment shall be furnished, installed or provided, it shall be understood to mean this Contractor shall furnish and install completely, unless it is specifically stated that the equipment is to be furnished and installed by others.

- E. The Architect/Engineer reserves the right to determine space priority of the contractors in the event of interference between the piping and equipment of the various contractors. Conflicts between the drawings and specifications, or between requirements set forth for the various trades, shall be called to the attention of the Architect/Engineer. If clarification is not asked for prior to the taking of bids, it will be assumed that none is required, and that the Contractor has submitted his bid in conformance with plans and specifications as issued and that no interference exists.
- F. No piping or equipment foreign to an elevator hoistway and machine room shall be run inside the hoistway or machine room in accordance with NEC 620.37 and ASME A17.1 Safety Code for Elevators and Escalators.

## 1.8 GUARANTEE AND MAINTENANCE

- A. Materials and equipment shall be guaranteed to be free from defects and to be new equipment; no secondhand, used or salvaged equipment will be allowed. The Owner's existing equipment which is to be relocated or reinstalled under this contract shall be refurbished, cleaned and repaired, and made subject to the guarantee and maintenance as herein specified, unless specifically noted otherwise.
- B. Keep the entire portion of the work in repair, without additional cost to the Owner, so far as defects in workmanship, apparatus, material or construction are concerned for one (1) year from the date of final acceptance, except as otherwise specified herein.
- C. Equipment which fails to meet performance ratings as specified and shown on the drawings shall be removed and replaced by new equipment that meets the specified requirements, without additional cost to the Owner.
- D. Materials and workmanship shall be subject to the review of the Architect/Engineer, in whose presence various tests shall be made as required by these specifications.

## PART 2 PRODUCTS

### 2.1 SUBMITTALS

- A. Submit shop drawings and catalog data for plumbing equipment as called for in Division 01 - General Requirements.
- B. Submittal data for plumbing equipment shall consist of shop drawings and/or catalog cuts showing technical data necessary to evaluate the material or equipment to include dimensions, wiring diagrams, performance curves, rating, and other descriptive data necessary to describe fully the item proposed and its operating characteristics. Shop drawings shall be submitted on equipment and materials as required by the specifications.
- C. Approval of materials, including alternate or substitute items, shall be obtained in writing from the Architect/Engineer, verbal approval will not be considered binding.
- D. Shop drawings shall be submitted and shall have been signed, checked, approved, and initialed by the Contractor prior to submittal to the Architect/Engineer. The Architect/Engineer will review shop drawings to aid in interpreting the plans and specifications and will in so doing assume that the shop drawings conform to specified requirements set forth in this specification. The approval of the shop drawing by the Architect/Engineer does not relieve the Contractor of the responsibility of complying with elements of the specification. The name of the job, Architect/Engineer, location, and specification section shall appear on all pages of shop drawings. Equipment marks (such as S-1, WH-1) shall be indicated for each item.

- E. Near completion of project, before conducting Owner orientation and training sessions and before authorization of final payment, submit to the Owner or their designated Representative for review: three (3) sets of installation and operational information, parts lists, and maintenance instructional manuals. These OMMs shall be organized, formatted and bound in accordance with Division 01 - General Requirements.
- F. At the completion of the project, prepare and submit to the Owner record drawings showing the location of piping and valves. Drawing shall give accurate dimensions of such equipment for future use by the Owner. This drawing shall be submitted as soon as work is completed and before authorization of final payment.

## 2.2 SUBCONTRACTORS AND MATERIALS

- A. Submit to the Architect/Engineer for review, when requested, a list of subcontractors, materials and equipment proposed to be used. The list must be reviewed by the Architect/Engineer before this Contractor may enter into any subcontractual agreement. Equipment, materials, and devices, etc. shall be subject to the review of the Architect/Engineer, whether or not said items are herein specified.

## 2.3 STANDARDS OF MATERIALS AND WORKMANSHIP

- A. Materials shall be new, complete with manufacturer's guarantee or warranty, and shall be as listed by Underwriters Laboratories (UL), Inc., American Water Works Association (AWWA), American Gas Association (AGA), etc., if a standard has been established by that agency for the type of material.
- B. Materials shall also comply with applicable standards of the National Electrical Manufacturer's Association, National Board of Fire Underwriters, National Fire Protection Association, National Safety Council, National Bureau of Standards, the National Electrical Code and the Williams-Steiger Occupational Safety and Health Act of 1970. Such standards are hereby made a part of these specifications.
- C. Work shall be performed by workmen skilled in the particular craft, shall be executed in a workmanlike manner, and shall present a neat mechanical appearance when completed. Align, level and adjust equipment for satisfactory operation, and install so that connecting and disconnecting of piping and accessories can be made readily and so that parts are easily accessible for inspection, operation and maintenance. Methods and techniques of installation shall be subject to the review of the Architect/Engineer.
- D. Materials shall be the standard product of a reputable manufacturer regularly engaged in the manufacture of the specific product. Materials of the same type of class shall be the products of one manufacturer. For example, faucets shall be from the same manufacturer.
- E. Materials shall be protected from damage, and stored indoors or protected from the weather at all times, unless other storage arrangements are approved by the Architect/Engineer.
- F. Bearing lubrication fittings shall be as recommended by the manufacturer and shall be extended, where necessary, to an accessible location.
- G. Material and equipment shall be installed in strict accordance with the manufacturer's recommendations.

## 2.4 MATERIAL SUBSTITUTIONS

- A. Proposals as submitted shall be based on the products specifically named in the specification or on the drawings. Material or equipment by manufacturers other than those specified may be used only by permission of the Architect/Engineer. Such permission for substitution must be requested, in writing and in accordance with Division 01 - General Requirements.

- B. The Architect/Engineer reserves the sole right for the approval of proposed material or equipment, and the phrase, "or approved equivalent", used in these specifications, or on the drawings, shall be interpreted to mean an equivalent approved by the Architect/Engineer.
- C. Changes required by alternate equipment shall be made at no additional cost to the Owner; and costs incurred by other trades, public utilities or the Owner, as a result of the use of such equipment, shall be the responsibility of the Contractor.
- D. Furnish to the Architect/Engineer, when requested, samples of proposed material or equipment substitutions. These samples shall remain with the Architect/Engineer as long as needed.
- E. Identify the differences in alternate material or equipment as compared to that specified, and indicate the benefits to the project as a result of selecting the alternative.
- F. The Architect/Engineer reserves the right to refuse approval of equipment which does not meet the specification, in their opinion, or of equipment for which no local experience of satisfactory service is available. The Architect/Engineer further reserves the right to reject equipment for which maintenance service and the availability of replacement parts is questionable.

## 2.5 JOINING MATERIALS

- A. Refer to individual Division 22 piping sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
      - 1) AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
  - 1. ABS Piping: ASTM D 2235.
  - 2. CPVC Piping: ASTM F 493.
  - 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
  - 4. PVC to ABS Piping Transition: ASTM D 3138.
  - 5. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

## 2.6 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. Available 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.
      - 1) Underground Piping NPS 1-1/2 (DN 40) and Smaller: Manufactured fitting or coupling.
      - 2) Underground Piping NPS 2 (DN 50) and larger: AWWA C219, metal sleeve-type coupling.
      - 3) Aboveground Pressure Piping: Pipe fitting.
  2. Plastic-to-Metal Transition Fittings: PVC and CPVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
    - a. Available Manufacturers:
      - 1) Eslon Thermoplastics.
  3. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
    - a. Available Manufacturers:
      - 1) Thompson Plastics, Inc.
  4. 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.
    - a. Available Manufacturers:
      - 1) NIBCO INC.
      - 2) NIBCO, Inc.; Chemtrol Div.
  5. Flexible Transition Couplings for Underground and Aboveground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.
    - a. Available Manufacturers:
      - 1) Cascade Waterworks Mfg. Co.
      - 2) Fernco, Inc.
      - 3) Mission Rubber Company.
      - 4) Plastic Oddities, Inc.

## 2.7 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 (1725-kPa) minimum working pressure at 180 deg F (82 deg C).
  - 1. Available 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.

## 2.8 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 (34.5-MPa), 28-day compressive strength.
  - 3. Packaging: Premixed and factory packaged.

## PART 3 EXECUTION

### 3.1 EXISTING CONDITIONS

- A. Examine the existing buildings and grounds or site and become familiar with the conditions as they exist, or that will in any manner affect the work under this contract. No allowance will be made subsequently, in this connection, on behalf of the Contractor for any error or negligence by the Contractor.
- B. Existing equipment, such as duct or pipe, in or on the existing building and grounds which is to be replaced, or which interferes in any way with the remodeling of the existing facilities and/or installation of new equipment, shall be removed from the premises or relocated by this Contractor, as directed by the Architect/Engineer. Do not remove from the premises any equipment that may have maintenance value to the Owner without permission of the Owner. Equipment, duct or pipe not to be reused shall be removed from the premises, unless otherwise noted herein or shown on the drawings.
- C. Where existing equipment is removed or changed, all piping no longer in service shall be removed and stubs plugged as directed by the Architect/Engineer. Building surfaces damaged and openings left by removal of equipment shall be repaired by the proper trades and paid for by this Contractor, unless otherwise noted on the drawings. The cutting and fitting shall be done by this Contractor. The cutting of floor, ceiling or wall surfaces shall be done by this Contractor with extreme care, in order to avoid any disrupting or damage of existing utility services which may be encountered. Coordinate with other trades and with the General Contractor or Construction Manager to minimize the damage to the building in order to reduce the amount of patching required.
- D. Where new openings are cut and concealed piping is encountered, such items shall be removed or relocated as required. Where systems to be removed stub through floors, walls or ceilings, openings shall be patched so that no evidence of the former installation remains.

- E. Existing active services (water, gas, sewer, electric), when encountered, shall be protected against damage. Do not prevent or disturb operation of active services that are to remain. If active services are encountered which require relocation, make request to authorities with jurisdiction for determination of procedures. Where existing services are to be abandoned, they shall be terminated in conformance with requirements of the utility or municipality having jurisdiction.
- F. The location, size and elevation of underground utilities shown on the drawings are in accordance with data supplied by the Owner and/or the various utility companies. The Contractor shall verify this data and shall report any discrepancies to the Architect/Engineer, in writing, before submitting his bid.

### 3.2 INTERRUPTION OF SERVICE

- A. Changes in service shall be made so as to provide a minimum of interference with the operation of services in the building. When changes require shutdown of building services, notify the proper building authorities no less than 48 hours in advance and obtain approval from these authorities before making changes. Such notices shall give duration and nature of shutdown. Temporary arrangements shall be approved by the Architect/Engineer and/or Owner.
- B. Any and all interruptions to building services shall be in accordance with Division 01 - General Requirements.

### 3.3 PIPING SYSTEMS - COMMON REQUIREMENTS

- 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 at indicated slopes.
- F. Install fittings for changes in direction and branch connections.
- G. Install piping to allow application of insulation.
- H. Select system components with pressure rating equal to or greater than system operating pressure.

### 3.4 OPENINGS, CUTTING, AND PATCHING

- A. The General Contractor shall coordinate the placing of openings in the new structure, as required for the installation of the plumbing work.
- B. Furnish to the General Contractor the accurate locations and sizes for required openings. This shall not relieve this Contractor of the responsibility of checking to assure that proper size openings are provided. When additional patching is required due to this Contractor's failure to inspect this work, this Contractor shall make arrangements for the patching required to properly close the opening, to include patch painting. This Contractor shall pay any additional cost incurred in this respect.

- C. When cutting and patching of the structure is made necessary due to this Contractor's failure to install piping, sleeves or equipment on schedule, or due to this Contractor's failure to furnish, on schedule, the information required for the leaving of openings, it shall be this Contractor's responsibility to make arrangements for this cutting and patching. This Contractor shall pay any additional cost incurred in this respect.

### 3.5 EXCAVATION AND BACKFILL

- A. See Division 31 - Trenching and Backfilling for requirements for trench excavation, backfill, and compaction.
- B. Contractor shall coordinate all related activity with General Contractor at least 24 hours before beginning construction activity.
- C. The Contractor shall be responsible for erecting and monitoring of all safety barricades and related protection around excavation and work areas.
- D. Trenches and excavations may be backfilled by the Contractor only after required testing has been satisfactorily performed and locations of connections and appurtenances which will be concealed have been recorded by the Contractor in the construction record documents.

### 3.6 CONCRETE AND MASONRY WORK

- A. Concrete work included herein or shown on the drawings shall be in conformance with Division 3 - Concrete.
- B. Concrete work included herein or shown on the drawings shall be done only by experienced cement finishers. Brickwork, where included, shall be laid only by experienced brick masons. Brick shall be of uniform size, hard burned, and shall be laid in cement mortar, except for patch work at a location where cement and lime mortar has previously been used. Exposed, finish brickwork shall match existing brickwork as closely as practical and shall be to the satisfaction of the Architect/Engineer and Owner.
- C. Concrete bases and pads for mechanical equipment will be furnished by General Contractor. This Contractor shall coordinate size and location.
- D. Locate, furnish and install all support, hanger and equipment anchor bolts and related hardware.

### 3.7 ROOF OPENINGS

- A. Roof openings required by this Contractor that are not shown on the Structural or Architectural Drawings shall be cut and adequately reinforced by an experienced roofing contractor.
- B. Roof penetrations for piping shall be through curbed roof openings. Equipment supports shall be by curbed and flashed runners meeting current National Roofing Contractor Association (NRCA) standards and details. Pitch pockets, pitch pans, and wood blocking are not acceptable.
- C. All roof work shall be completed such that it does not void any existing roof warranty.

### 3.8 PAINTING

- A. The finish of any item that has been marred, scratched or damaged in any way by this Contractor shall be repainted at the expense of this Contractor, and to the satisfaction of the Architect/Engineer and the Owner.
- B. Painting and finishing of exposed mechanical systems including piping and duct shall be as shown on the drawings and per Division 9 - Finishes.

### 3.9 CLEANING

- A. Keep the premises clean of all dirt and debris, caused by the work in accordance with Division 1 - General Requirements.
- B. Keep the premises clean of all debris caused by the work at all times, and keep materials stored, in areas designated by the Owner, in such a manner as not to interfere with the progress of the work of other Contractors or with the operation of existing facilities.
- C. At the conclusion of the construction, the site shall be thoroughly cleaned of all rubble, debris and unused material and shall be left in good order. Closed off spaces shall be cleaned of waste such as material, cartons, and wood frame members used in the construction.

### 3.10 WIRING FOR PLUMBING EQUIPMENT

- A. The Division 26 Contractor shall provide power including connection to all electrically powered equipment furnished by the Division 22 Contractor. Where electrical disconnect switches are not explicitly specified to be furnished as part of Division 22 equipment, the Electrical Contractor shall furnish suitable type(s) and properly rated electrical disconnect switches for all said mechanical equipment.
- B. Provide integral wiring, alarm wiring, control wiring, temperature control wiring and interlock wiring for equipment furnished, whether or not such wiring is furnished by the equipment vendor.
- C. Except as noted otherwise or where other sections call for motor starters to be furnished by manufacturers as part of their equipment, the Division 26 Electrical Contractor shall furnish motor starters as required for motors furnished by this Division 22 Contractor.
- D. Furnish shop drawings including but not limited to detailed schedules and wiring diagrams to other interested trades including Division 26 electrical contractor for all electrically powered equipment furnished. Schedules shall include: electrical loads and characteristics, max. overcurrent fuse protection / circuit breaker needs, disconnect requirements, motor starter requirements and motor horsepower(s). Include drawings as needed to depict locations of electrical and control panels, service clearances, disconnects as well as wiring connection points.
- E. The Division 22 Contractor shall be responsible to pay for all additional costs incurred due to equipment substitutions by Division 22 Contractor, which require either larger electrical service or service of a different electrical characteristic than scheduled on the Drawings.
- F. Prior to bid submission, this Division 22 Contractor shall review the Electrical Drawings and promptly bring to the attention of the Architect/Engineer, any omissions or errors in the electrical services required for equipment proposed to be furnished.

### 3.11 MOTORS

- A. Motors 1/2 HP and smaller shall be 120 volt 1-phase unless noted otherwise.
- B. All motors that are indicated to be used with Variable Frequency Drives (VFDs) shall be inverter duty rated. Coordinate all motor requirements with the Electrical Contractor.

### 3.12 PROTECTION

- A. Special steps shall be taken as necessary for the protection of equipment and materials furnished under Division 22. Equipment and materials shall be protected by Contractor from any physical damage due to weather elements, dirt, dents, sheet rock installation, and painting until the project is completed. Damage, if incurred, shall be promptly repaired at no additional cost to Owner, as-needed to restore equipment and materials to original as-new condition.

- B. Protection of equipment during the finishing (sheet rock, plastering and painting) of the building interior shall be the responsibility of the contractor or contractors performing that work. This shall not relieve this Division 22 Contractor of the ultimate responsibility of checking and ensuring that adequate protection is provided and maintained at all times.
- C. Where the installation or connection of equipment requires Division 22 Contractor to work in areas previously finished by other Contractors, the Division 22 Contractor shall be responsible to ensure that such finished areas are adequately protected and are not marred, soiled or otherwise damaged during the course of their said work. If damage occurs this Division 22 Contractor shall be responsible to arrange for the other Contractors to repair and refinish any damaged areas and shall pay for all repair, rework and refinishing required.
- D. When heavy materials must be placed upon or transported over the roof deck, sheeting shall be placed to distribute the weight and support such materials. Any damage shall be immediately corrected at no cost to the Owner.

### 3.13 ASBESTOS IDENTIFICATION AND CONTROL

- A. In the event that suspected asbestos containing material (ACM) is encountered during the course of the work, cease operations in the immediate area and promptly notify both the Owner and Architect/Engineer. Suspected materials will then be sampled and analyzed by the Owner's Representative.
- B. Should ACM be confirmed, the Owner's Representative shall direct the abatement procedures. This work shall be awarded either by subcontract to the Contractor or under a separate contract.
- C. During abatement operations, cease operations in the immediate area of the abatement. Operations in other areas of the project may be performed, but care must be taken to control dust to avoid contamination of air monitoring samples. The Contractors shall coordinate activities with the asbestos abatement contractor as well as the Owner's Representative.
- D. Should no ACM be identified, operations in the restricted areas may be resumed. At the discretion of the Owner or Owner's representative, any schedule delays caused by identification, analysis or abatement may be added in the form of an extension of time to the contract via a Change Order.

### 3.14 NOISE AND VIBRATION

- A. Contractor shall install all equipment in a such a manner so as to control the transmission of noise and vibration from any installed equipment, components or systems, so the sound level in any occupied area does not exceed NC-35 levels. Contractor shall correct all objectionable noise levels in any occupied areas and at no additional cost to Owner, which are due to improperly installed or isolated equipment, components or systems.

### 3.15 TESTS AND DEMONSTRATIONS

- A. Systems shall be tested and placed in proper working order prior to demonstrating systems to the Owner.
- B. Prior to acceptance of the plumbing installation, demonstrate to the Owner or his designated representatives essential features and functions of all systems installed, and instruct the Owner in the proper operation and maintenance of such systems.
- C. Furnish the necessary trained personnel to perform the demonstrations and instructions and arrange to have the manufacturer's representatives for the system present to assist with the demonstrations. The Owner and Contractor shall each sign a certification stating that the training has been performed and the Owner accepts same.

### 3.16 UTILITY REBATE APPLICATIONS

- A. This contractor shall be responsible for gathering information necessary for completing local utility rebate applications and submitting to the proper utility companies for gas and electric rebates. Potential rebates include high efficiency gas boilers, thermostats, timeclocks, motors, and other items furnished by this plumbing contractor.

**END OF SECTION 22 0500**

SECTION 22 05 29  
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Provide equipment, materials, labor and supervision necessary to install pipe hangers and supports.
- B. Pipe support systems shall secure pipes in place, prevent pipe vibration, provide vertical adjustment for maintaining required grades, and provide for expansion and contraction.
- C. Where supports are attached to concrete or other structural members, care shall be taken to prevent damage or weakening of the structural members.
- D. Where concrete inserts are to be used, it shall be this Contractor's responsibility to accurately locate and attach inserts to concrete forms.

1.2 REFERENCE STANDARDS

- A. American National Standards Institute, ANSI:
  - 1. ANSI B31.1 Power Piping
  - 2. ANSI B31.9 Building Services Piping
- B. Manufacturers Standardization Society of the Valve and Fittings Industry, MSS, 1815 North Fort Myer Drive, Arlington, VA 22209.
  - 1. MSS SP-58: Pipe Hangers and Supports - Materials, Design and Manufacturer.
  - 2. MSS SP-69: Pipe Hangers and Supports - Selection and Application.
- C. Anvil International, 2 Holland Way, Exeter, NH 03833, [www.anvilintl.com](http://www.anvilintl.com), (603) 418-2800.
  - 1. Pipe Hangers and Supports Catalog (Jan. 2015)

1.3 DEFINITIONS

- A. Pipe Hanger: A device normally suspended from structure and is used to carry the piping weight in tension.
- B. Pipe Support: A device by which piping is normally carried from beneath and is used to carry the piping weight in compression.

1.4 SUBMITTALS

- A. Submit manufacturer's product data on all hangers and support devices. Product data to include, but not be limited to materials, finishes, approvals, load ratings, and dimensional information.

**PART 2 PRODUCTS**

2.1 HANGERS AND SUPPORTS

- A. Hangers and support devices shall be Anvil International Inc., Tolco, Fee and Mason, Michigan, B-Line or Engineer approved equivalent. Figure numbers within are based on Anvil International, Inc.

**PART 3 EXECUTION**

**3.1 INSTALLATION - HORIZONTAL PIPE SUPPORTS**

- A. Hanger rods for steel, wrought iron and brass pipe shall be installed in accordance with MSS SP-69 Tables 3 and 4 and the following schedule:

| <b>Pipe Size</b>       | <b>Rod Diameter</b> | <b>Maximum Spacing</b> |
|------------------------|---------------------|------------------------|
| Up to 1 1/4"           | 3/8"                | 7'-0"                  |
| 1 1/2" and 2"          | 3/8"                | 9'-0"                  |
| 2"                     | 3/8"                | 10'-0"                 |
| 2 1/2", 3", and 3 1/2" | 1/2"                | 10'-0"                 |
| 4" and 5"              | 5/8"                | 12'-0"                 |
| 6"                     | 3/4"                | 12'-0"                 |
| 8"                     | 7/8"                | 14'-0"                 |
| 10" and 12"            | 7/8"                | 16'-0"                 |
| 14" and 16"            | 1"                  | 16'-0"                 |
| 18"                    | 1 1/8"              | 18'-0"                 |
| 20" and 24"            | 1 1/4"              | 20'-0"                 |

- B. Hanger rods for copper pipe and tube shall be installed in accordance with MSS-SP-69 Tables 3 and 4 and the following schedule:

| <b>Pipe Size</b>   | <b>Rod Diameter</b> | <b>Maximum Spacing</b> |
|--------------------|---------------------|------------------------|
| 1/2" and 3/4"      | 3/8"                | 5'-0"                  |
| 1"                 | 3/8"                | 6'-0"                  |
| 1 1/4"             | 3/8"                | 7'-0"                  |
| 1 1/2"             | 3/8"                | 8'-0"                  |
| 2"                 | 3/8"                | 8'-0"                  |
| 2 1/2"             | 1/2"                | 9'-0"                  |
| 3", 3 1/2", and 4" | 1/2"                | 10'-0"                 |
| 5"                 | 1/2"                | 13'-0"                 |
| 6"                 | 5/8"                | 14'-0"                 |
| 8"                 | 3/4"                | 16'-0"                 |

- C. Support horizontal cast iron soil pipe with two hangers for each pipe length. Locate hangers close to couplings.
- D. In addition to the above specified spacings, install additional hangers at change in pipe direction and at concentrated loads, large valves and strainers.
- E. Where more than one pipe is to be run parallel together, they may be supported on trapeze type hangers. Trapeze bar angles and hanger rods shall be of sufficient size to support the particular group of pipes. Trapeze hanger spacing shall be based on the smallest pipe on the rack. When hanging from light gauge metal trusses, coordinate pipe hanger spacing and hanger rod connection points with the truss manufacturer.
- F. For suspending hanger rods from brackets attached to walls, use welded steel brackets: Fig. 194 for loads up to 750 lbs; Fig. 195 for loads up to 1500 lbs; Fig. 199 for loads up to 3000 lbs.
- G. Where pipes are to be racked along walls, use "Unistrut" pipe racks or 12-gauge steel strut channel, 1-5/8" x 1-5/8" minimum.



1. Mount pipes to strut channel with two-piece pipe straps to match outside diameter of pipe including insulation.
- H. Attach all pipe hangers from support rods using double locknuts tightened to prevent loosening.

### 3.2 INSTALLATION - VERTICAL PIPE SUPPORTS

- A. Support vertical steel, wrought iron, copper and brass pipe at every other floor line.
- B. Support vertical cast iron soil pipe at every floor line.
- C. In addition to the above, support vertical pipes at base of riser with base fitting set on concrete or brick pier, or by hanger located on horizontal connection close to riser.
- D. Where pipe sleeves extend above floor, place pipe clamps at ceiling below and support clamp extensions from inserts or other approved attachment.

### 3.3 PIPE ATTACHMENTS

- A. For horizontal steel and wrought iron pipe, use carbon steel adjustable clevis hanger, Fig. 260. For floor support or support directly above steel beams, use adjustable pipe roll stand, Fig. 177.
- B. For horizontal copper pipe and tube, use copper-plated, carbon steel adjustable swivel ring, Fig. CT-69.
- C. When thermal expansion for horizontal pipe is in excess of  $\frac{1}{2}$ " axially, use adjustable steel yoke pipe roll, Fig. 181, or adjustable pipe roll stand, Fig. 177.
- D. For horizontal cast iron soil pipe, use carbon steel adjustable clevis hanger, Fig. 260.
- E. For vertical steel, wrought iron and cast-iron pipe, use extension pipe or riser clamps, Fig. 261.
- F. For vertical copper pipe and tube, use copper-plated, copper plated copper tubing riser pipe clamp, Fig. CT-121.

### 3.4 INTERMEDIATE ATTACHMENTS

- A. Hanger rods: Carbon steel single or double end threaded, Figs. 140, 253 as required. Continuous threaded rod, Fig. 146 may be used wherever possible.
- B. Chain wire or perforated strap hangers will not be permitted. One pipe shall not be suspended from another pipe.

### 3.5 STRUCTURAL ATTACHMENTS

- A. For attaching steel or copper plated hanger rods to reinforced concrete, use galvanized malleable iron universal concrete inserts; Fig. 282 for loads up to 1140 lbs.
- B. For attaching steel hanger rods to structural steel beams, use malleable iron C-clamps; Fig. 92, Fig. 93 or Fig. 94 with retaining clip Fig. 89 or Fig. 89X for loads up to 500 lbs; Fig. 218 with extension piece for loads up to 1,365 lbs. For copper plated hanger rods, use copper plated malleable iron C-clamps; Fig. CT-138R for loads up to 180 lbs.
- C. For attaching steel hanger rods to wood structural members, use malleable iron ceiling flange; Fig. 153 for loads up to 1,270 lbs. For copper plated hanger rods, use copper plated malleable iron ceiling flange: Fig. CT-128R for loads up to 180 lbs.
- D. Vertical expansion shields or toggles shall not be used for suspending hanger rods, except with permission in cases where inserts have been omitted or cannot be used. If permitted, use expansion shields; for rod sizes up to  $\frac{1}{2}$ ", 320 lbs. max. load. For hanger rods larger than  $\frac{1}{2}$ " use attachment plate, Fig. 52, with wedge anchors.

E. Powder actuated anchoring methods shall not be used.

3.6 PIPE COVERING PROTECTION

A. Hangers and supports for insulated piping shall not injure or pierce insulation. Provide insulation protection shields in conjunction with hanger or roll device. Use Fig. 160 and 165, Protection Saddles.

3.7 SUPPLEMENTAL STEEL

A. Provide supplemental steel as required to hang or support plumbing equipment or piping.

**END OF SECTION 22 0529**

SECTION 22 05 53  
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Provide materials, equipment labor and supervision necessary to install piping identification products.
- B. Comply with ANSI A13.1 for lettering size, length or color field, colors, and installed viewing angles of identification devices.

1.2 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; The American Society of Mechanical Engineers; 2007.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2013.

1.3 SUBMITTALS

- A. Submit manufacturer's product data.
- B. Submit sample of each type of identification product and clearly identify the contents in a schedule.
- C. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- D. Schedule:
  - 1. Submit valve schedule for each system, typewritten and reproduced on 8-1/2" x 11" bond paper. Tabulate valve ID tag number, system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves that are intended for emergency shut-off and similar special uses, by special "flags" in margin of schedule.

**PART 2 PRODUCTS**

2.1 MANUFACTURERS

- A. Brady Corp., Industrial Safety Supply, Emedco, Seton or Brimar.
- B. Engineer approved alternative

2.2 PIPE MARKERS

- A. Provide manufacturer's standard preprinted, semi-rigid snap-on or self-sticking, color-coded pipe markers, complying with ANSI A13.1.
- B. Provide full-band pipe markers, extending 360° around pipe at each location or self-sticking pipe markers, fastened in the following method:
  - 1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
  - 2. Secure to piping and install banding tape on both ends of each pipe label.
- C. Lettering shall be manufacturer's pre-printed nomenclature which best describes piping system in each instance, as selected by Architect/Engineer in cases of variance.

- D. Print each pipe marker with arrows indicating direction of flow, integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic or on banding tape.

### 2.3 EQUIPMENT MARKERS

- A. Provide engraved signage nameplates and tags constructed of multi-layered acrylic that has been treated for outdoor use and can withstand temperatures up to 160° F. Nameplates shall have beveled edges with contrasting color core, letters, and border. Minimum size of nameplate shall be 3" high by 6" long. The minimum letter height shall be 3/4". Attachment shall be by double faced 2 mil permanent acrylic adhesive. For equipment that doesn't allow for direct attachment, furnish sheet metal backing to integrate with equipment such that signage can be read from 5 feet above the finished floor. Unless noted otherwise, signage shall be provided with black lettering, black border, and yellow core. All signage shall include up to 14 characters per line, minimum of 3 lines per tag. Furnish signage for equipment shown in Section 3:
  - 1. All pumps shall include the full name description for system served such as "*Primary Chilled Water Pump – 1.*"
- B. All equipment shall be named consistent with the plans and specifications as indicated on the schedules or as directed by the Owner.

### 2.4 BRASS VALVE TAGS

- A. Provide manufacturer's standard brass valve tags with stamped black filled lettering, with piping system abbreviation in 1/4" high letters and sequenced valve numbers 1/2" high, and with 3/16" hole for fastener.
- B. Provide 1-1/2" round brass tags with black lettering. Seton 250 BL or equal.

### 2.5 VALVE TAG FASTENERS

- A. Manufacturer's standard solid brass chain or solid brass S-hooks of sizes required for proper attachment of tags to valves and manufactured specifically for that purpose.

### 2.6 PIPING AND EQUIPMENT IDENTIFICATION

- A. Piping systems that shall be identified by their controls (including directional arrows) on this project shall include, but are not necessarily limited to the following:
  - 1. Domestic cold water, hot water, and hot water recirculation.
  - 2. Storm Water.
  - 3. Sanitary and sanitary vent.
- B. Provide name plates for all equipment scheduled on the drawings. Coordinate nameplate tag with Owner's sequencing system. If the Owner has no preference, the nameplates shall correspond with the equipment schedule. Equipment shall include but is not limited to the following:
  - 1. Pumps.
  - 2. Expansion tanks.
  - 3. Water heaters.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION OF MECHANICAL IDENTIFICATION**

- A. Where identification is to be applied to surfaces that require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.
- B. Install pipe markers on each system and include arrows to show normal direction of flow.
- C. Locate pipe markers as follows: wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) above lay-in type ceilings and exterior non-concealed locations.
  - 1. Near each valve and control device.
  - 2. Near each branch, excluding short take-offs for fixtures, mark each pipe at branch where there could be question of flow pattern.
  - 3. Near locations where pipes pass through walls or floors/ceilings, (both sides) or center non-accessible 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. At each pipe passage to underground.
  - 7. Spaced intermediately at maximum spacing of 50 feet along each piping run, except reduce spacing to 25 feet in congested areas of piping and equipment.
  - 8. On piping above removable acoustical ceilings, maximum spacing of 10 feet along each piping run.
  - 9. Where self-sticking labels are used, the pipe or its covering surface shall be properly prepared. This consists of removal of loose dirt, oil and grease, loose paint or peeling insulation covering. This can be done with a brush and cloth; washing is not required. Use solvent for removal of oil or grease.
  - 10. Banding tape must be used on both ends of all self-sticking labels. The tape shall encircle the pipe completely and overlap itself so the banding tape can adhere to itself.
- D. Provide valve tags for all major valves 1/2" size or larger. Included are all main, zone and branch valves, valves in all equipment rooms, etc. All types of valves, ball, globe, butterfly, cocks, control, regulating, relief, reducing, solenoid, etc. are to be identified except check valves. Do not identify end use point valves for plumbing fixtures, and similar rough-in connections.
- E. List each tagged valve in schedule for each system showing function and location. Provide separate charts for mechanical divisions of work. Charts shall be installed on a conspicuous wall in the main mechanical equipment room. Provide unframed copies of valve lists as part of closeout documents.

### **3.2 ADJUSTING AND CLEANING**

- A. Relocate any mechanical identification device which has become visually blocked by work of this division or by other divisions.
- B. Clean face of identification devices and glass frames of valve schedules.

**END OF SECTION 22 0553**

SECTION 22 07 00  
PLUMBING INSULATION

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Provide equipment, materials, labor and supervision necessary to install insulation to hot and cold surfaces of piping, tanks, ductwork, fittings and other surfaces.
- B. Insulation shall include insulating materials, jackets, adhesive, mastic coatings, tie wire and other materials as required to complete the insulating work.

1.2 CODES AND STANDARDS

- A. Insulating materials, jackets and mastics shall meet flame spread, fuel contribution and smoke developed ratings in accordance with NFPA-90A. Flame spread rating in accordance with NFPA 255, ASTM E-84, or UL 723 of not more than 25; smoke developed rating of not more than 50, unless otherwise noted in this section.
- B. Insulation that has been treated with a flame-retardant additive to meet the flame spread and smoke developed ratings shown above is not permitted.
- C. Insulation materials shall be non-corrosive to the materials they are applied to, including stress corrosion cracking of stainless steel and shall not breed or promote mold, fungus or bacteria.
- D. Insulation shall meet or exceed all requirements of ASHRAE/IES 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.

1.3 QUALIFICATION

- A. Insulating materials by Owens-Corning, Armacell, Pittsburgh-Corning, Knauf, Johns Manville, or Engineer approved equivalent.
- B. Mastics and adhesives as recommended by the insulation manufacturer.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation and jacket. Submit schedule showing manufacturer's product number, flame spread and smoke development rating, k-value, density, temperature limitations, sound absorption coefficients, thickness, and furnished accessories for each mechanical system requiring insulation.

**PART 2 PRODUCTS**

2.1 INSULATION

- A. Description:
  - 1. Type A: Preformed, sectional, heavy density fiberglass insulation, suitable for operating temperatures form - 20 F to +850 F. Equipped with factory-applied, all-service vapor barrier jacket constructed of white Kraft paper bonded to aluminum foil reinforced with fiberglass yarn, with pressure-sensitive, self-sealing longitudinal laps and butt strips. Thermal conductivity of 0.23 BTU-in/hr-ft<sup>2</sup>- F @ 75 F mean temperature. Water vapor permeance of 0.02 perms. Johns Manville "Micro-Lok HP or Engineer approved equivalent.

2. Type B: Flexible, elastomeric pipe and sheet insulation with closed-cell structure. Shall comply with ASTM C534, Type I, Grade 1 for tubular materials and ASTM C534 Type II, Grade 1 for sheet materials. Suitable for operating temperatures from -40° F to 220° F. Outdoor applications, and where otherwise noted, shall receive a weather-resistant, protective, latex enamel finish. Thermal conductivity of 0.28 BTU-in/hr-ft<sup>2</sup>-°F @ 75° F mean temperature. Water vapor permeance of 0.08 perms. Insulation shall be equivalent to Armacell AP Armaflex; adhesive equivalent to Armacell Armaflex 520 or Armaflex 520 BLV Low-VOC Contact Adhesive; finish equivalent to Armacell Armaflex WB finish.
3. Type C: Flexible, elastomeric thermal insulation with an expanded, closed-cell structure. Pre-slit tubular form with a pressure-sensitive adhesive strip for closure and vapor sealing of the longitudinal joint. Butt joints, sealed with 3M-471 tape. White color. Suitable for operating temperature of 40 F to 200 F. Thermal conductivity of 0.28 BTU-in/hr-ft<sup>2</sup>- F mean temperature. Water vapor permeance of 0.20 perms. Insulation shall be Armacell Self-Seal Armaflex 2000 or Engineer approved equivalent.

## 2.2 PIPE INSULATION SCHEDULE

### **SERVICE TYPE THICKNESS PIPE SIZES**

| SERVICE                            | TYPE  | THICKNESS    | PIPE SIZES         |
|------------------------------------|-------|--------------|--------------------|
| DOMESTIC COLD                      | A,B,C | 1/2"         | ALL SIZES          |
| DOMESTIC HOT AND<br>HOT WATER CIRC | A,B,C | 1"<br>1-1/2" | <1-1/2"<br>≥1-1-2" |
| HORIZONTAL STORM                   | A,B,C | 1"           | ALL SIZES          |
| UNDERSIDE OF<br>ROOF DRAINS        | B     | 1"           | ALL SIZES          |

## 2.3 EQUIPMENT INSULATION SCHEDULE (ASHRAE 90.1)

### **SERVICE TYPE THICKNESS**

PIPE ANCHORS / GUIDES      B    3/4"

## 2.4 INSULATION JACKETS

- A. 20-mil high impact PVC secured with spray contact adhesive. All PVC jacketing shall meet the 25/50 SDR. Manville "Zeston 2000" or equivalent.
- B. 6-oz/sq yd UL listed cotton canvas fabric secured with Childers CP50 lagging adhesive.
- C. Fitting and valve jackets shall be premolded PVC with joints and seams sealed with a spray contact adhesive or vapor barrier mastic. Premolded jackets shall be Manville "Zeston 2000" or approved equivalent.
- D. At wall penetrations and on exterior pipe, provide an additional jacket of 0.020 inch thick smooth finish aluminum secured with 0.015 inch thick, 3/8-inch wide aluminum bands. Metal jacket shall have factory applied moisture barrier. Fitting and valve covers to be preformed of same material as adjacent metal jacket.
- E. Where PVC or metal jackets are used, delete the factory applied ASJ on pipe and equipment operating above 75° F.
- F. PVC jackets shall be used in the following areas and systems:
  1. Whenever piping is routed exposed through occupied spaces.
  2. Exposed piping in kitchens and dishwasher rooms.

3. Premolded PVC at all fittings and valve jackets.

### **PART 3 EXECUTION**

#### **3.1 GENERAL**

- A. Use only experienced applicators regularly engaged in the trade. Rough work will be rejected. Application details shall be in accordance with the insulation materials supplier's recommendations, except where a higher standard is specified.
- B. Install materials after systems have been tested and approved. Material such as rust, scale, dirt and moisture shall be removed from surfaces to be insulated.
- C. Insulation shall be kept clean and dry at all times.
- D. Where pipes and ducts pass through fire rated walls, floors and partitions, a fire seal shall be provided.
- E. When flexible cellular insulation is used, it shall be installed with seams and joints sealed with contact adhesive.
  1. Wherever possible, the insulation shall be placed over the pipe before it is installed. Seal the butt joints with Armacell Armaflex 520, or Armaflex 520 BLV Low-VOC Contact Adhesive or equal.
  2. Where the insulation cannot be slipped on, cut the insulation longitudinally and apply it to the piping. Seal longitudinal seam and butt joints with Armacell Armaflex 520 adhesive, or Armaflex 520 BLV Low-VOC Contact Adhesive or equal. In all cases, the insulation, equal to Armacell AP, protected with half-round PVC sleeves the length of three times the nominal pipe size, minimum length to be 8 inches.

#### **3.2 PIPE INSULATION INSTALLATION**

- A. Insulate fittings, valves, unions, flanges, strainers, flexible connections and expansion joints with premolded or mitered segments of same insulating material as for adjacent pipe covering.
- B. Pipe insulation shall continue through sleeves and hangers with vapor barrier and/or jacket.
- C. Insert to be between support shield and piping but under the finish jacket. Provide an insert at hangars not less than 6 inches long, of same thickness and contour as adjoining insulation, to prevent insulation from sagging at support points. Inserts shall be heavy density insulating material suitable for the planned temperature range. Factory fabricated inserts may be used.
- D. Neatly finish insulation at supports, protrusions and interruptions.
  1. On hot systems where fittings are to be left exposed, insulation ends shall be beveled away from bolts for easy access.
  2. On cold systems, valve stems shall be sealed with caulking which allows free movement of the stem, but provides a seal against moisture incursion.
- E. Wherever piping penetrates a floor or is exposed in a finished area such as kitchens, furnish a floor pipe escutcheon and/or PVC (white) jacket to protect insulation and allow for a smooth finish for cleaning.

#### **3.3 EQUIPMENT INSULATION INSTALLATION**

- A. Do not insulate factory-insulated equipment.
- B. Apply insulation as close as possible to equipment by grooving, scoring and beveling insulation, if necessary. Secure insulation to equipment with studs, pins, clips, adhesive, wires or bands.



- C. Fill joints, cracks, seams and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.
- D. Cover insulation with metal mesh and finish with ¼" coat of insulating cement applied in two 1/8" layers, if non-faced insulation is used.
- E. When equipment with insulation requires periodical opening for maintenance, repair or cleaning such as at manway covers or strainer plugs, install insulation in such a manner that it can be easily removed and replaced without damage. Removable insulation shall have a vapor-proof cover fabricated so as to allow it to be resealed to the equipment vapor barrier.
- F. Joints shall be sealed with 2" wide vapor barrier tape or strips to match insulation jacket, using a fire-resistive adhesive.

**END OF SECTION 22 0700**

SECTION 22 11 16  
DOMESTIC WATER PIPING

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Provide equipment, materials, tools, labor, and supervision necessary to furnish, fabricate, and install complete piping system.

1.2 CODES AND STANDARDS

- A. Pipe materials specified in this Section shall apply to technical sections of Division 22 of the Project Manual where applicable. Special requirements as may be called for in the technical sections, or shown on the Drawings, shall take precedence over General Requirements herein. Piping located in plenums shall be plenum rated for fire and smoke.
- B. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content =0.25% per Safe Drinking Water Act as amended January 4, 2011, Section 1417.
- C. NSF Compliance: NSF/ANSI 61 and/or NSF/ANSI 372 for valve materials for potable-water service. Valves for domestic water must be 3rd Party Certified.

1.3 PRODUCT HANDLING

- A. Provide factory-applied plastic end-caps on each length of pipe and tube. Maintain end-caps through shipping, storage, and handling as required to prevent pipe-end damage and eliminate dirt and moisture from inside of pipe and tube.
- B. Where possible, store pipe and tube inside and protected from weather. Where necessary to store outside, elevate well above grade and enclose with durable, waterproof wrapping.
- C. Protect flanges and fittings from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

1.4 SUBMITTALS

- A. For each system served: Submit piping schedule listing, by range of sizes, piping material used.
- B. Submit manufacturer's specifications and/or catalog data including material and pressure test certifications for pipe, fittings, valves, and other related items including but not limited to pipe hangers and supports.
- C. Locations of connections to existing water lines, service lines, valves, and water main appurtenances shall be submitted as a dimensioned drawing Owner's Representative or Architect/Engineer for construction record purposes.

## PART 2 PRODUCTS

### 4.1 MATERIAL

#### A. Piping:

| MATERIAL                                           | SERVICE                                                                                                                                            |
|----------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| Copper Water Tub, Hard Temper ASTM B88             |                                                                                                                                                    |
| Type K                                             | Domestic water piping lines under building, concealed in solid concrete or masonry walls or construction; underground water service, up to 3" dia. |
| Type L                                             | Above ground domestic water pipes                                                                                                                  |
| Brass pipe, Schedule 40, Chromium plated, ASTM B43 | Exposed piping connections for plumbing fixtures, showers and chrome plated tanks.                                                                 |

#### B. Fittings:

1. Copper water tube, cast bronze or wrought copper, solder joint type. ANSI B16.18 and B16.22.
2. Brass pipe - cast bronze screwed, 125 pound, flat band water pattern, chromium plated, for chromium-plated pipe.

### 4.2 JOINTS

- A. Copper water and drainage tube - use 95-5 tin antimony or silver solder, cut pipe square, clean and polish tube ends and inner surface of fittings, apply flux and solder joint as recommended by manufacturer of solder type fittings. Use same methods for copper refrigerant pipe, except use silver solder with 15% silver content, equivalent to Sil-Flos 15.
- B. Threadless brass pipe - use brazing alloy which will flow freely at 1300 degree F. Use flux and brazing method as recommended by manufacturer of brazing alloy.
- C. When soldering use paste fluxes that are approved by the manufacturer for use with Lead Free Alloys.

### 4.3 GENERAL VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. If valve applications are not indicated, use the following:
  1. Shutoff Service: Ball, Butterfly, or Gate valves.
    - a. Piping NPS 2 (DN 50) and smaller: Furnish bronze ball or gate valves.
    - b. Piping NPS 2-1/2 (DN 65) and larger: Furnish cast-iron butterfly or gate valves with flanged ends.
  2. Throttling - Balancing Service: Globe, Ball, or Butterfly valves.
    - a. Piping NPS 2 (DN 50) and smaller: Furnish bronze ball or globe valves.

- b. Piping NPS 2-1/2 (DN 65) and larger: Furnish cast-iron butterfly valves with flanged ends.
  - 3. Hot-Water Piping, Balancing Duty: thermostatic balancing valve. Thermomega Circuit solver or equivalent.
  - 4. Drain Duty: Hose-end drain valves.
  - 5. Butterfly Valve Dead-End Service: Single-flange (lug) type.
  - 6. Pump-Discharge Check Valves:
    - a. NPS 2 (DN 50) and Smaller: Spring-loaded lift valves with nonmetallic disc.
    - b. NPS 2-1/2 (DN 65) and Larger for Domestic Water: Center-guided metal-seat check valves.
- B. Select valves, except wafer types, with the following end connections:
  - 1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded, Sweat solder, or Press-to-fit ends.
  - 2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Grooved Mechanical Coupling, Flanged, or Threaded ends .
- C. If valves with specified CWP ratings are not available, the same types of valves with CWP ratings may be substituted.

#### 4.4 NIPPLES AND UNIONS

- A. Nipples shall conform to size, weight, and strength of adjoining pipe. When length of unthreaded portion of nipple is less than 1-1/2", use extra strong nipple; do not use close nipples.
- B. For pipe 3" and smaller, use screwed unions; over 3", use flanged unions. For steel and wrought iron pipe, use malleable iron ground joint unions, black or galvanized, to conform to pipe. Cast iron flanged unions are to be gasket type. For threaded brass pipe, use bronze ground joint unions with octagon ends. Install unions on equipment intended to be disassembled.
- C. Dielectric unions shall be installed between connections of copper pipe and ferrous piping.

#### 4.5 SLEEVES

- A. Floor sleeves shall be provided by the contractor. Coordinate with existing structure and notify engineer if structure interferes with design.
- B. Sleeves passing through non-load bearing walls and partitions shall be galvanized sheet steel with lock seam joints of minimum gauges as follows: For pipes 2-1/2" in size and smaller - 24-gauge; 3 in. to 6 in. - 22-gauge; over 6 in. - 20-gauge.
- C. Sleeves passing through load bearing walls, concrete beams, fireproof walls, foundations, footings, and waterproof floors shall be Schedule 40 galvanized steel pipe or cast iron pipe.
- D. Sleeves for insulated piping shall be of sufficient internal diameter to take pipe and insulation and to allow for free movement of pipe. Waterproof sleeves shall be of sufficient internal diameter to take pipe and waterproofing material.
- E. In finished areas where pipes are exposed, sleeves shall be terminated flush with wall, partitions and ceilings, and shall extend 1/2 in. above finished floors. Extend sleeves 1 in. above finished floors in areas likely to entrap water and fill space between sleeves and pipe with graphite packing and caulking compound.
- F. Sleeves passing through membrane waterproofing or roofing shall be flashed and sealed.

#### 4.6 PIPE ESCUTCHEONS

- A. Provide pipe escutcheons with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extensions, if any. Furnish pipe escutcheons with chrome finish for occupied areas, prime paint finish for unoccupied areas.
- B. Pipe Escutcheons for Moist Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide cast brass or sheet brass escutcheons, solid or split hinged.
- C. Pipe Escutcheons for Dry Areas: Provide sheet steel escutcheons, solid or split hinged.
- D. Manufacturer: Chicago Specialty; Producers Specialty; or Sanitary-Dash.

#### 4.7 GUARDS

- A. Where exposed insulated piping extends through floor, provide sheet metal guard around insulation to extend up from floor 60 inches. Guard to be galvanized sheet steel not less than 26-gauge.

#### 4.8 FIRE SAFING

- A. Metal piping and sleeves passing through floors, roof, partitions and fire walls, shall be provided with firestop by packing space between pipe and sleeve with UL listed non-sag and self-leveling fire safing insulation per manufacturer's instructions.
- B. Plastic piping passing through fire rated floors and fire rated walls shall be provided with firestop by providing intumescent wrap strip around the pipe, enclosed in steel collar attached to structure.
- C. Cracks, Voids, or Holes Up to 4" Diameter: Use non-sag or self-leveling putty or caulking, one-piece intumescent elastomer, non-corrosive to metal, compatible with synthetic cable jackets, and capable of expanding 10 times when exposed to flame or heat, UL listed.
- D. Openings 4" or Greater: Use sealing system capable of passing 3-hour fire test in accordance with ASTM E814, consisting of wall wrap or liner, partitions, and end caps capable of expanding when exposed to temperatures of 250 to 350 degree F (121 to 177 degree C), UL listed.
- E. Seal all holes or voids made by penetrations to ensure an effective barrier against smoke, fire, toxic and combustible gases.
- F. Unless protected, from possible loading or traffic, install firestopping materials in floors having void openings or four (4) inches or more to support the same floor load requirements.
- G. Manufacturer: Subject to compliance with requirements, provide non-sag and self-leveling fire barrier caulk, wrap/strip, moldable putty and sheet forms of one of the following:
  - 1. 3M Brand.
  - 2. Flame Stop.
  - 3. Dow Corning.
  - 4. Metacaulk.
- H. Horizontal penetrations through fire rated walls where plenum rated cables or tubing bundles are being installed shall be made with EZ-Path Fire-rated Pathway by Specified Technologies, Inc.

#### 4.9 MECHANICAL SLEEVE SEALS

- A. Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.
- B. Manufacturer: Thunderline.

### **PART 3 EXECUTION**

#### 5.1 INSTALLATION

- A. Install pipe for plumbing and mechanical systems as shown on the Drawings, as called for in other Sections, and as specified herein
- B. Arrange and install piping approximately as indicated, straight, plumb, and as direct as possible, form right angles on parallel lines with building walls. Keep pipes close to walls, partitions, and ceilings, offsetting only where necessary to follow walls and avoid interference with other mechanical items. Locate groups of pipes parallel to each other; space at a distance to permit applying full insulation and to permit access for servicing valves. Piping to be run in concealed locations unless indicated exposed, or in equipment rooms.
- C. Install horizontal piping as high as possible without sags or humps so that proper grades can be maintained for drainage. Branch piping shall come off the tops of mains unless shown otherwise.
- D. Locate valves within reachable distance from equipment being served for easy access and operation. Do not locate valves with stems below horizontal.
- E. Check piping for interference with other trades; avoid placing water pipes over electrical equipment.
- F. Verify final equipment locations before roughing in.
- G. Where rough-ins are required for equipment furnished by others, verify exact rough-in dimensions with Owner or equipment supplier before roughing-in.
- H. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 (DN 50) and smaller. Use butterfly or gate valves for piping NPS 2-1/2 (DN 65) and larger.
- I. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
  - 1. Install hose-end drain valves at low points in water mains, risers, and branches.
  - 2. Install stop-and-waste drain valves where indicated.

#### 5.2 SLEEVES

- A. Install sleeves for piping passing through floors, roof, walls and foundations.
- B. Install fire-proofing per manufacturer's written instructions.

#### 5.3 ESCUTCHEONS

- A. Install escutcheons for pipes entering finished spaces.

#### 5.4 MECHANICAL SLEEVE SEAL INSTALLATION

- A. Install mechanical sleeve seals at all pipe penetrations through foundations below grade.
- B. Loosely assemble rubber links around pipe and bolts and pressure plates located under each bolt head and nut. Push into sleeve and center. Tighten bolts until links have expanded to form watertight seal.

#### 5.5 PIPE PENETRATIONS

- A. Penetrations shall be free of debris and dirt. Dam the penetration (when required) with an acceptable material. Apply firestop material to the penetration per manufacturer's installation instructions. Use a caulking gun, putty knife or other normal trade tools. Remove damming materials where necessary after cure. Clean up with Xylene.

#### 5.6 FIRE SAFING

- A. Install fire safing at all penetrations through walls, floors, etc. per manufacturer's installation instructions as required to meet UL listing.

#### 5.7 FIELD QUALITY CONTROL

- A. Inspect domestic water piping as follows:
  - 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
  - 2. 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:
    - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
  - 3. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.
  - 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- B. Test domestic water piping as follows:
  - 1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
  - 2. 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.
  - 3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  - 4. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
  - 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.

## 5.8 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 plugs used 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.

## 5.9 CLEANING

- A. Domestic water piping shall be cleaned and disinfected prior to substantial completion. Immediately prior to occupancy, the system(s) shall be flushed and a water sample submitted to the local Water Works for testing.
- B. Clean and disinfect potable domestic water piping as follows:
  1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
  2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as 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 (50 mg/L) 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 (200 mg/L) of chlorine. Isolate and allow to stand for three hours.
        - (a) Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
        - (b) Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.
- D. Prepare and submit reports of purging and disinfecting activities.

**END OF SECTION 22 1116**



SECTION 22 11 19  
DOMESTIC WATER PIPING SPECIALTIES

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Provide materials, equipment, labor, and supervision necessary to install water supply system as required by the Drawings and this Section.

1.2 CODES AND STANDARDS

- A. ASSE 1011 - Hose Connection Vacuum Breakers.
- B. ASSE 1019 - Vacuum Breaker Wall Hydrants, Freeze Resistant Automatic Draining Type.
- C. ASSE 1052 - Performance Requirements for Hose Connection Backflow Preventers.
- D. ANSI / AWWA, C700
- E. The Plumbing and Drainage Institute - PDI Standard WH 201 for Water Hammer Arrestors
- F. Uniform Plumbing Code.
- G. NFPA Codes and Standards
- H. University of Southern California Foundation for Cross-Connection Control and Hydraulic Research - USCFCCC.
- I. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content =0.25% per Safe Drinking Water Act as amended January 4, 2011, Section 1417.
- J. NSF Compliance: NSF/ANSI 61 and/or NSF/ANSI 372 for valve materials for potable-water service. Valves for domestic water must be 3rd Party Certified.

1.3 SUBMITTALS

- A. Product data: Submit manufacturer's specifications and/or catalog data including material and pressure test certifications for all equipment herein.
- B. Installation, Operations and Maintenance data.
  - 1. Include signed copies of certified testing results reports.

1.4 EXTRA MATERIALS

- A. Furnish the following extra materials to Owner at the completion of the project:
  - 1. A spare service kit for each installed backflow preventer.
  - 2. Extra Hose End Vacuum Breakers for Hose Bibbs - One
  - 3. Extra Loose Keys for Exterior Wall Hydrants and Hose Bibbs: Two.

## **PART 2 PRODUCTS**

### **2.1 GENERAL**

- A. Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes and types matching piping and equipment connections; provide fittings of materials that match pipe materials used in water supply systems. Where more than one type of material or product are indicated, selection is Installer's option.

### **2.2 WATER HAMMER ARRESTORS**

- A. Water hammer arrestors shall be piston type of copper construction, sized and certified to function in accordance with PDI Standard WH 201.
- B. Units shall be pre-charged and suitable for operation in temperature 34° F to 250° F (1° C to 120° C) and maximum 150 psi (1000kPa) working pressure and shall be designed so as to limit surge pressure to 150 lbs. from a flow velocity of 10 fps at 60 psig through 50 feet of pipe the same size as the shock absorber.
- C. Manufacturer: Subject to compliance with requirements, provide water hammer arrestors manufacture by one of the following:
  - 1. Sioux Chief (piston type only, where specified)
  - 2. Watts
  - 3. Zurn
  - 4. JR Smith
  - 5. Wade
  - 6. Josam
  - 7. MIFAB
  - 8. Precision Plumbing Products
  - 9. Engineer approved equivalent

### **2.3 BACKFLOW PREVENTERS**

- A. Backflow prevention devices shall be designed and tested for compliance with USCFCCC manual for cross connection control, and ASSE and AWWA standards as applicable to backflow prevention and cross connection control.
- B. Atmospheric Vacuum Breaker
  - 1. Anti-siphon vacuum breaker shall be brass body with polished chrome finish and include lightweight disc float with water hammer resistant silicone disc to assure tight seating.
  - 2. Units shall be installed a minimum 6" above highest point of water outlet.
  - 3. Device shall NOT be used under continuous pressure, or where there is a possibility that a back pressure condition may develop.
  - 4. Units shall have temperature and pressure ratings not less than 110° F and 125 psi working pressure.
  - 5. Manufacturer: Subject to compliance with requirements, provide vacuum breakers manufactured by one of the following:
    - a. Febco
    - b. Watts

- c. Zurn, Wilkins Division
  - d. Engineer approved equivalent
- C. Hose Connection Vacuum Breaker
- 1. Anti-siphon vacuum breaker shall be brass body with polished chrome finish and include stainless steel working parts and durable rubber diaphragm and disc for positive seating.
  - 2. Device shall NOT be used under continuous pressure or where there is a possibility that a back pressure condition may develop.
  - 3. Units shall have temperature and pressure ratings not less than 110° F and 125 psi working pressure.
  - 4. Manufacturer: Subject to compliance with requirements, vacuum breakers manufactured by one of the following:
    - a. Febco
    - b. Watts
    - c. Zurn, Wilkins Division
    - d. Woodford
    - e. Engineer approved equivalent

#### 2.4 THERMOSTATIC MIXING VALVES

- A. Valve shall be chrome-plated brass body with paraffin activation technology integral temperature adjustment. Reference plumbing fixture schedule for size and flow requirements.
- B. Cabinet shall be as scheduled for recessed or surface mounting with keyed lock.
- C. Manufacturer: Subject to compliance with requirements, provide valves manufactured by one of the following:
  - 1. Holby Valve Company
  - 2. Lawler
  - 3. Leonard
  - 4. Symmons Industries
  - 5. Powers
  - 6. Engineer approved equivalent

#### 2.5 WALL HYDRANTS

- A. Manufacturer: Subject to compliance with requirements, provide wall hydrants manufactured by one of the following:
  - 1. Woodford
  - 2. Watts
  - 3. Engineer approved equivalent
- B. Freeze resistant, ASSE 1019, auto-draining, stainless steel stem, one piece valve plunger, copper casing tubes, wall clamp with rough finish, chrome plated box and lockable cover, hose thread spout, lock shield with removable key and ASSE 1052 approved backflow preventer.

## 2.6 ROOF HYDRANTS

- A. Manufacturer: subject to compliance with requirements, provide roof hydrants manufactured by one of the following
  - 1. Woodford
  - 2. Watts
  - 3. Engineer approved equivalent
- B. Freeze resistant

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Extend cold water and hot water piping to each fixture and other equipment requiring water supplies.
- B. Generally follow indicated lines, exact layout to be made on job for alignment with surrounding work and space for covering.
- C. Pitch pipes to accessible drainage point where unions, plugged tees or drainage valves shall be provided.
- D. Install water hammer arrestors on each service at each fixture or group of fixtures.
- E. Water supply to fixtures and containers shall be so installed as to prevent back siphonage of polluted water into the water supply. Supplies shall be either above the flood rim of the fixture or separated from the drainage end by means of approved vacuum breakers.
- F. Provide valves as shown and specified herein. Branch serving four or more fixtures shall be provided with an accessible shut-off valve.
- G. Pipes built into masonry or concrete construction shall be wrapped with tar paper or burlap to prevent bonding to the concrete.
- H. No pipe shall be located in an outside wall or other location where freezing is likely to occur, and no pipe shall be in contact with or attached to a structural member in a manner that causes the transmission of noise to the structure. Block ends of runs to prevent movement due to water hammer.
- I. Consult with utility company for water meter requirements. Provide shut-off valves upstream and downstream of meters.
- J. Install approved backflow prevention devices on plumbing lines where contamination of domestic water may occur, including, but not limited to, the following locations. Install devices in accordance with manufacturer's instructions, complete with accessories as required.
  - 1. Custodial rooms
  - 2. Interior and exterior hose connections
- K. Extend relief piping from backflow prevention devices to nearest floor drain.
- L. Install water hammer arrestors, complete with accessible isolation valves on hot and cold water supply piping to all plumbing fixtures.

### 3.2 TESTING AND CLEANING

- A. Test, flush and clean domestic water piping specialties per Section 22 1116 " Domestic Water Piping" requirements and in compliance with the Uniform Plumbing Code. Certification of testing results shall be provided to Owner in writing.

B. Backflow Prevention:

1. After system test, flushing, and chlorinating, backflow preventer shall be disassembled by a certified backflow specialist and all debris shall be cleared from the valve, reassembled, and tested to verify proper operation.
2. Inspect and flow test all backflow preventers in accordance with NFPA 13 and or NFPA 25 requirements and ASSE testing procedures and protocols.
3. Certification of testing results shall be provided to Owner in writing

**END OF SECTION 22 1119**

SECTION 22 11 23  
DOMESTIC WATER PUMPS

**GENERAL**

1.1 SECTION INCLUDES

- A. Provide materials, equipment, labor and supervision necessary to install pumps as required by the Drawings and this Section.

1.2 QUALIFICATIONS

- A. Centrifugal pumps shall be by Aurora, Bell & Gosset, TACO, Armstrong or PACO. Model numbers and electrical characteristics as scheduled on Drawings.

1.3 PERFORMANCE AND TEST

- A. Pump capacities and ratings shall be as scheduled on Drawings.
- B. Pump performance and motor characteristics shall be such that motor will not be loaded beyond its service factor if operating head is reduced to 80% of specified head.
- C. Pumps shall be factory-tested at specified conditions.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's pump specifications, installation and start-up instructions, and current accurate pump characteristic performance curves with selection points clearly indicated.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.
- C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to pumps. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

**PRODUCTS**

2.1 DOMESTIC WATER CIRCULATING PUMP(S)

- A. Pump(s) shall be in-line type for installation in vertical or horizontal piping and shall be capable of being serviced without disturbing piping connections.
- B. Pump body shall be cast bronze ASTM #B584, rated 175 psi working pressure, with gauge ports at nozzles, and with vent and drain ports.
- C. Impeller shall be non-ferrous material, enclosed type, dynamically balanced, keyed to the shaft and secured by a locking cap screw or nut.
- D. The liquid cavity shall be sealed from the pump bearing by an internally-flushed mechanical seal with ceramic seat of at least 98% alumina oxide content, and carbon seal ring, suitable for continuous operation at 225° F. A non-ferrous shaft sleeve shall completely cover the wetted area under the seal.
- E. Pump bearing bracket shall have oil lubricated bronze journal and thrust bearings. Bracket shaft shall be alloy steel having ground and hardened thrust bearing faces. A flexible coupling to dampen starting torque and torsional vibrations shall be employed.

- F. The motor shall meet NEMA specifications.
- G. Each pump shall be factory tested. It shall then be thoroughly cleaned and painted with at least one coat of high-grade machinery enamel prior to shipment.
- H. Each pump shall be checked by the contractor and regulated for proper differential pressure, voltage and amperage draw. This data shall be noted on a permanent tag or label and fastened to pump for owner's reference.

## 2.2 FINISH

- A. Pumps shall be thoroughly cleaned and painted with machine enamel prior to shipment.
- B. Finish marred during installation shall be touched up.

## EXECUTION

### 3.1 PREPARATION

- A. In-line pumps shall be mounted in accordance with the pump manufacturer's recommendations. Layout piping system to accommodate motor removal requirements.

### 3.2 INSTALLATION

- A. Install pumps for all fluid systems as required by the Drawings.
- B. Provide the following for each centrifugal pump:
  - 1. Flexible connector in suction and discharge line.
  - 2. Strainer or Suction diffuser and shutoff valve in suction line.
  - 3. Check valve, flow indicator, and shutoff or Triple duty valve in discharge lines.
  - 4. Pressure gauge with snubbers and turn cocks in both pump suction and discharge.
- C. Suction inlet pipe for centrifugal pumps shall be a straight section of pipe of not less than five (5) pipe diameters in length between pump suction flange and any change in direction of suction line. Where space conditions will not permit suction inlet pipe of required length, provide a suction diffuser installed per manufacturer's instructions.
- D. In-line pumps shall be supported in accordance with the pump manufacturer's instructions.

### 3.3 START-UP ASSISTANCE

- A. The manufacturer shall provide start-up assistance in the form of a factory trained service technician.

**END OF SECTION 22 1123**

SECTION 22 13 16  
SANITARY WASTE AND VENT PIPING

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Provide equipment, materials, tools, labor, and supervision necessary to furnish, fabricate, and install a complete soil, waste and vent system.

1.2 CODES AND STANDARDS

- A. Pipe materials specified in this Section shall apply to other technical sections of Division 22 of the Project Manual where applicable. Special requirements as may be called for in the technical sections, or shown on the Drawings, shall take precedence over General Requirements herein. Piping located in plenums shall be plenum rated for fire and smoke.
- B. Local and/or State Plumbing, Mechanical and Building Codes
- C. Uniform Plumbing Code
- D. International Mechanical Code
- E. NFPA Codes and Standards

1.3 PRODUCT HANDLING

- A. Provide factory-applied plastic end-caps on each length of pipe and tube. Maintain end-caps through shipping, storage, and handling as required to prevent pipe-end damage and eliminate dirt and moisture from inside of pipe and tube.
- B. Where possible, store pipe and tube inside and protected from weather. Where necessary to store outside, elevate well above grade and enclose with durable, waterproof wrapping.
- C. Where possible, store pipe and tube inside and protected from weather. Where necessary to store outside, elevate well above grade and enclose with durable, waterproof wrapping.

1.4 SUBMITTALS

- A. For each system served: Submit piping schedule listing, by range of sizes, piping material used.
- B. Submit product and performance data for equipment specified herein
- C. Locations of connections to existing sanitary sewer lines, storm water lines, and related invert elevations shall be submitted as a dimensioned drawing to the Owner's Representative or Architect/Engineer for construction record purposes.



**PART 2 PRODUCTS**

**5.1 SANITARY SEWERS, SOIL, WASTE AND VENT MATERIALS**

**A. Piping:**

| MATERIAL                                                                                     | SERVICE                                                                                             |
|----------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|
| Cast iron soil pipe, service weight, bell and spigot, ASTM A74<br>Asphalt coated<br>Uncoated | Sanitary and storm sewers.<br>Above ground soil, waste, vent and downspouts 3" dia. and larger.     |
| Copper water tube, hard temper, ASTM B88<br>Type M                                           | Above ground soil, waste, vent and downspouts up to and including 3" dia.                           |
| Copper drainage tube, hard temper, Type DWV, ASTM B306.                                      | Above ground soil, waste, vent and downspouts up to and including 2-1/2" dia. as permitted by Code. |
| Solid wall Schedule 40 PVC pipe, ASTM D2665, (DWV) drain, waste and vent.                    | Below ground soil, waste and vent piping                                                            |

**B. Fittings**

1. Material and strength of fittings for cast sewer pipes, clay sewer pipes, and concrete sewer pipe shall conform to pipe as per ASTM Standards.
2. Ductile iron and grey Iron fittings - Class 250, ANSI/AWWA C110 A21.10, standard mechanical joint fitting with lugs for connecting to pipe.
3. Copper drainage tube (M) - Cast bronze fittings, solder joint fittings. ANSI B.16, 23-69.
4. Solid wall Schedule 40 PVC DWV - solvent cemented joints per ASTM D2665.

**C. Joints**

1. Cast iron bell and spigot soil pipe - pipe manufacturer's standard preformed, preset plastic or rubber joint, installed in accordance with manufacturer's instructions.
2. Cast iron no-hub pipe - coupling assembly tightened by torque wrench.
  - a. Conforming to ASTM C1540 Performance Requirements, CISPI 310, and NSF certified, type 300 series stainless steel shield secured by two or more stainless steel worm drive clamps, ASTM C564 gasket, one piece neoprene compression gasket.
  - b. Manufacturers:
    - 1) Clamp All: Hi-Torq 80
    - 2) MG Coupling
    - 3) Ideal Tridon
    - 4) Engineer approved equivalent

3. Copper water and drainage tube - use 95-5 tin antimony or silver solder, cut pipe square, clean and polish tube ends and inner surface of fittings, apply flux and solder joint as recommended by manufacturer of solder type fittings. Use same methods for copper refrigerant pipe, except use silver solder with 15% silver content, equivalent to Sil-Flos 15.
4. Solid wall Schedule 40 PVC DWV - solvent cemented joints per ASTM D2665.

## 5.2 VENTS

- A. Vents through the roof shall be cast iron and shall extend at least above the highest possible water level on the roof but in no case less than 12 inches.
- B. Provide a flashing of 4-pound sheet lead for each vent through the roof. The flashing shall extend up around the pipe and turn down into it at least 2 in. and shall extend over the roof deck at least 1 ft. in each direction from the base.
- C. Coordinate flashing of vents through the roof with General Contractor or Roofing Contractor.
- D. Where vents through the roof are subject to frost or snow closure the vent termination shall be increased beginning at least 12 in. under the roof with a cast iron long increaser. Size increasers as follows:

| Vent Size               | Increase To   |
|-------------------------|---------------|
| 1-1/4 in. and 1-1/2 in. | 3 in. minimum |
| 2 in. and 2-1/2 in.     | 4 in. minimum |
| 3 in.                   | 5 in.         |
| 4 in.                   | 6 in.         |

## 5.3 SLEEVES

- A. Sleeves passing through non-load bearing walls and partitions shall be galvanized sheet steel with lock seam joints of minimum gauges as follows: For pipes 2-1/2" in size and smaller - 24-gauge; 3 in. to 6 in. - 22-gauge; over 6 in. - 20-gauge.
- B. Sleeves passing through load bearing walls, concrete beams, fireproof walls, foundations, footings, and waterproof floors shall be Schedule 40 galvanized steel pipe or cast iron pipe.
- C. Sleeves for insulated piping shall be of sufficient internal diameter to take pipe and insulation and to allow for free movement of pipe. Waterproof sleeves shall be of sufficient internal diameter to take pipe and waterproofing material.
- D. In finished areas where pipes are exposed, sleeves shall be terminated flush with wall, partitions and ceilings, and shall extend 1/2 in. above finished floors. Extend sleeves 1 in. above finished floors in areas likely to entrap water and fill space between sleeves and pipe with graphite packing and caulking compound.
- E. Sleeves passing through membrane waterproofing or roofing shall be flashed and sealed.

## 5.4 PIPE ESCUTCHEONS

- A. Provide pipe escutcheons with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extensions, if any. Furnish pipe escutcheons with chrome finish for occupied areas, prime paint finish for unoccupied areas.
- B. Pipe Escutcheons for Moist Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide cast brass or sheet brass escutcheons, solid or split hinged.
- C. Pipe Escutcheons for Dry Areas: Provide sheet steel escutcheons, solid or split hinged.

D. Manufacturer: Chicago Specialty; Producers Specialty; or Sanitary-Dash.

## 5.5 GUARDS

A. Where exposed insulated piping extends through floor, provide sheet metal guard around insulation to extend up from floor 60 inches. Guard to be galvanized sheet steel not less than 26-gauge.

## 5.6 FIRE SAFING

- A. Metal piping and sleeves passing through floors, roof, partitions and fire walls, shall be provided with firestop by packing space between pipe and sleeve with UL listed non-sag and self-leveling fire safing insulation per manufacturer's instructions.
- B. Plastic piping passing through fire rated floors and fire rated walls shall be provided with firestop by providing intumescent wrap strip around the pipe, enclosed in steel collar attached to structure.
- C. Cracks, Voids, or Holes Up to 4" Diameter: Use non-sag or self-leveling putty or caulking, one-piece intumescent elastomer, non-corrosive to metal, compatible with synthetic cable jackets, and capable of expanding 10 times when exposed to flame or heat, UL listed.
- D. Openings 4" or Greater: Use sealing system capable of passing 3-hour fire test in accordance with ASTM E814, consisting of wall wrap or liner, partitions, and end caps capable of expanding when exposed to temperatures of 250 to 350oF (121 to 177oC), UL listed.
- E. Seal all holes or voids made by penetrations to ensure an effective barrier against smoke, fire, toxic and combustible gases.
- F. Unless protected, from possible loading or traffic, install firestopping materials in floors having void openings or four (4) inches or more to support the same floor load requirements.
- G. Manufacturer: Subject to compliance with requirements, provide non-sag and self-leveling fire barrier caulk, wrap/strip, moldable putty and sheet forms of one of the following:
1. 3M Brand.
  2. Flame Stop.
  3. Dow Corning.
  4. Metacaulk.

## 5.7 MECHANICAL SLEEVE SEALS

- A. Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.
- B. Manufacturer: Thunderline.

## **PART 3 EXECUTION**

### **6.1 INSTALLATION**

- A. Install underground building drains as shown and in accordance with the Uniform Plumbing Code. Lay underground building drains beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install required gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements. Clean interior of piping of dirt and other superfluous material as work progresses. Maintain swab or drag in line and pull past each joint as it is completed. Place plugs in ends of uncompleted piping at end of day or whenever work stops.
- B. Follow indicated lines generally but make exact layout on the job to work actual fitting dimensions, align piping, and avoid interference. Provide proper support to maintain uniform fall of 1/4 in. per ft. for lines 3 in. and smaller and 1/8 in. per ft. for lines larger than 3 inches. Protect openings against the entrance of dirt.
- C. No soil or waste pipe shall be covered by earth or concealed by construction without first being proven free of leaks by means of a hydrostatic water test of no less than 10-feet of head or pneumatic air test of no less than 5 PSI. Pressure shall be held constant for a period of not less than 15 minutes before beginning inspection or 15 minutes without the addition of air. Plastic pipe shall not be tested by air.
- D. Install vents in practical alignment and supported with constant pitch back to the drainage system, concealed from finished spaces, unless shown or directed otherwise.
- E. Soil, waste and vent connections to fixtures shall be accurately located and concealed from finished spaces, unless shown otherwise.
- F. Refer to Division 31 - Earthwork for excavating, trenching, and backfilling requirements.
- G. Contractor shall verify existing tie-in invert elevations of sanitary sewer piping prior to installation of new piping. Coordinate the site sewer tie-in invert elevation with the site utility contractor. Existing tie-in inverts that are discovered to be different from the information on the bid documents shall be reported to the General Contractor or Construction Manager and the Engineer immediately.
- H. Install no-hub couplings and uniformly tighten clamps to manufacture's recommended torque specifications. No-hub coupling joints shall be properly supported so as to not be exposed to bending.

### **6.2 SLEEVES**

- A. Install sleeves for piping passing through floors, roof, walls, concrete beams, and foundations.
- B. Install fire-proofing per manufacturer's written instructions.

### **6.3 ESCUTCHEONS**

- A. Install escutcheons for pipes entering finished spaces.

### **6.4 MECHANICAL SLEEVE SEAL INSTALLATION**

- A. Install mechanical sleeve seals at all pipe penetrations through foundations below grade.
- B. Loosely assemble rubber links around pipe and bolts and pressure plates located under each bolt head and nut. Push into sleeve and center. Tighten bolts until links have expanded to form watertight seal.

## 6.5 PIPE PENETRATIONS

- A. Penetrations shall be free of debris and dirt. Dam the penetration (when required) with an acceptable material. Apply fire stop material to the penetration per manufacturer's installation instructions. Use a caulking gun, putty knife or other normal trade tools. Remove damming materials where necessary after cure. Clean up with Xylene.

## 6.6 FIRE SAFING

- A. Install fire safing at all penetrations through walls, floors, etc. per manufacturer's installation instructions as required to meet UL listing.

## 6.7 TESTING AND CLEANING

- A. Provide labor, materials, facilities, and administration required to conduct the tests required under this section. Tests which fail to meet the specified performance shall be retested at no expense to the Owner. Repair all defective installations.
- B. Flush out piping system with clean water before proceeding with required tests. Inspect each run of each system for completion of joints, supports and accessory items.
- C. Testing shall be done in compliance with the Uniform Plumbing Code and to the satisfaction of the Authorities Having Jurisdiction.
- D. Perform final testing after all fixtures have been set and all traps have been filled with water.
- E. Hydraulic Water Testing:
  - 1. Hydraulically pressure test each section or segment of the soil, waste and vent system prior to backfilling, encasing, enclosing or otherwise preventing visual observation of the section or segment being tested or access to repair if needed.
  - 2. The system and all joints shall be tested with no less than 10 feet head of water pressure. Top of test standpipe to be filled with water shall be a minimum of 10 feet above the highest point of section being tested.
  - 3. The water shall be kept in the tested system or sub-section for not less than 15 minutes before inspection for leakage begins.
  - 4. All leaks shall be promptly repaired by replacing damaged or defective components with new parts and system shall be re-tested, repeating repair and re-testing steps as-needed, without additional cost to the Owner, until system is certified tight and leak free.
- F. Pneumatic Air Pressure Testing:
  - 1. Plastic piping shall not be tested with air. Do not over pressurize the system beyond maximum rating.
  - 2. Pneumatically pressure test with air each section or segment of the soil, waste and vent system prior to backfilling, encasing, enclosing or otherwise preventing visual observation of the section or segment being tested or access to repair if needed.
  - 3. The system and all joints shall be tested using an air compressor and pressure gauge or manometer testing apparatus.
  - 4. Fill tested system with air to a uniform, stabilized gauge pressure of 5 PSI. The system shall be held at the test pressure without the addition of air for a period of not less than 15 minutes.
  - 5. All leaks shall be promptly repaired by replacing damaged or defective components with new parts and system shall be re-tested, repeating repair and re-testing steps as-needed, without additional cost to the Owner, until system is certified tight and leak free.

**END OF SECTION 22 1316**

SECTION 22 13 19  
SANITARY WASTE PIPING SPECIALTIES

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Provide equipment, materials, labor and supervision necessary to install soil, waste and vent system.

1.2 CODES AND STANDARDS

- A. Local and/or State Plumbing, Mechanical and Building Codes
- B. Uniform Plumbing Code
- C. International Mechanical Code
- D. NFPA Codes and Standards

1.3 SUMMARY

- A. This Section includes the following sanitary drainage piping specialties:
  - 1. Floor drains.
  - 2. Cleanouts.
  - 3. Trench drains
  - 4. Miscellaneous sanitary drainage piping specialties.

1.4 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. FRP: Fiberglass-reinforced plastic.
- C. HDPE: High-density polyethylene plastic.
- D. PE: Polyethylene plastic.
- E. PP: Polypropylene plastic.
- F. PVC: Polyvinyl chloride plastic.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated, include rated capacities, operating characteristics, and accessories.
- B. Installation, Operations and Maintenance data. Include signed copies of certified testing results reports.

1.6 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

## **PART 2 PRODUCTS**

### **2.1 CLEANOUTS**

#### **A. General:**

##### **1. Floor:**

- a. In floors of finished areas - epoxy coated, cast iron caulking ferrule for soil pipe hub with brass countersunk plug and cast brass round flush access cover with polished top. Furnish carpet flange and cover and cleanout ID marker for all carpeted areas.
- b. In floors of unfinished areas - epoxy coated, cast iron with tapered body for caulking into soil pipe hub, with brass countersunk plug.

##### **2. Wall:**

- a. In walls of finished areas - Gas and watertight bronze tapered seat, raised head plug, iron pipe size (IPS) male threads and round polished stainless steel cover plate with countersunk stainless steel cover screw. Provide with caulking ferrule where installed in cast iron soil pipe.
- b. In walls of unfinished areas - Gas and watertight bronze tapered seat, raised head, iron pipe size (IPS) male threads. Provide with caulking ferrule where installed in cast iron soil pipe.

#### **B. Manufacturers: Subject to compliance with requirements, provide clean outs by one of the following:**

1. Zurn Plumbing Products Group
2. J.R. Smith
3. Wade
4. Watts Drainage Products Inc.
5. Engineer approved equivalent

### **2.2 FLOOR DRAINS**

#### **A. General:**

1. Body: Floor and shower drains shall be epoxy coated cast iron with bottom outlet, convertible membrane clamp, adjustable collar with seepage slots.
2. Strainer: Polished heavy-duty vandal-proof secured polished nickel bronze strainer and removable sediment bucket.
3. End Connections: hub and spigot, hubless, or threaded.

#### **B. Sizes: Refer to Project Drawings and Schedules.**

#### **C. Traps and Seals:**

1. Drains without integral traps shall have service weight cast iron P traps.
2. Provide trap primers on all floor drains and on other drains as shown on Drawings.

#### **D. Seepage Pans:**

1. Provide seepage pans of four pound sheet lead or Chloraloy 240 plastic at least 3' -0" square for all floor drains over open space. Lead, if used, shall be thoroughly coated with asphaltum before it is placed in contact with concrete or concrete fill is poured over it.

2. Provide seepage pans of four-pound sheet lead or Chloraloy 240 plastic to cover total area of showers over open spaces. Pan shall turn up at ends at least 9 inches and corners shall be folded and properly sealed. Lead, if used, shall be thoroughly coated with asphaltum before it is placed in contact with concrete or concrete fill is poured over it
  3. Flashing clamps and auxiliary drainage rims shall be provided for all drains that are to receive seepage pans.
- E. Manufacturers: Subject to compliance with requirements, provide clean outs by one of the following:
1. Zurn Plumbing Products Group
  2. J.R. Smith
  3. Wade
  4. Watts Drainage Products Inc.
  5. Engineer approved equivalent

## 2.3 TRENCH DRAINS

- A. General:
1. ASME A112.6.3 - compliant floor and trench Drains.
- B. Construction:
1. Epoxy coated cast iron with vertically and horizontally adjustable bottom outlet and anchor flange.
  2. 0% water absorbent high density polyethylene (HDPE) with bottom outlet and anchor flange.
  3. Membrane Clamping Device: Required.
  4. Seepage Pan: Required
  5. Strainer: Bottom dome and Removable stainless-steel basket.
  6. Trap: Cast iron standard P-trap.
- C. Grating: Vandal proof reinforced medium duty slotted, class A, polished nickel bronze grating.
- D. Manufacturers: Subject to compliance with requirements, provide a comparable product by one of the following:
1. Josam Company
  2. Jay R. Smith Mfg. Co.
  3. Mifab, Inc.
  4. Tyler Pipe; Wade Div.
  5. Watts Drainage Products Inc.
  6. Zurn Plumbing Products Group
  7. Engineer approved equivalent

## 2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

- A. Deep-Seal Traps
1. Description: Epoxy coated cast iron, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
  2. Size: Same as connected waste piping.



- a. NPS 2 (DN 50): 4-inch- (100-mm-) minimum water seal.
  - b. NPS 2-1/2 (DN 65) and Larger: 5-inch- (125-mm-) minimum water seal.
- B. Air-Gap Fittings
- 1. Description: Epoxy coated cast iron body, ASME A112.1.2, designed to ensure fixed, positive air gap between installed inlet and outlet piping.
  - 2. Size: Outlet shall be same size as connected waste piping and with inlet large enough for associated indirect waste piping. Unless noted otherwise the inlet to the air gap fitting shall be a larger size than the discharge of the piping leading into it.
- C. Expansion Joints
- 1. Description: ASME A112.21.2M compliant. Cast iron body with bronze sleeve, packing and gland.
  - 2. End Connections: hub and spigot, hubless, or threaded. Match piping connections.
  - 3. Size: Same as connected soil, waste, or vent piping.

## **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 wood-blocking reinforcement for wall-mounting-type specialties.
- C. 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.
- D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- F. Install 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.
  5. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
  6. Install deep-seal traps on floor drains, and other waste outlets unless otherwise indicated.
- G. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- H. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

### 3.2 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.

### 3.3 FIELD QUALITY CONTROL

- A. Tests and Inspections:
1. Leak Test: After installation, charge system 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.

### 3.4 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 22 1319**

SECTION 22 13 29  
SANITARY SEWERAGE PUMPS

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Provide materials, equipment, labor and supervision necessary to install sanitary sewer ejector pumps as required by the Drawings and this Section.

1.2 CODES AND STANDARDS

- A. Local and/or State Plumbing, Mechanical and Building Codes
- B. Uniform Plumbing Code
- C. NFPA Codes and Standards

1.3 SUMMARY

- A. This Section includes the following sump pump system equipment:
  - 1. Submersible Sewage Pumps
  - 2. Sewage Pump Basins and Covers
  - 3. Controls

1.4 QUALIFICATIONS

- A. Sump pumps shall be by the following manufacturers. Model numbers and electrical characteristics as scheduled on Drawings.
  - 1. Weil Pump Company
  - 2. Hydro-Matic
  - 3. Zoeller
  - 4. Goulds
  - 5. Barnes
  - 6. Engineer approved equivalent

1.5 PERFORMANCE AND TESTING

- A. Pump capacities and ratings shall be as scheduled on Drawings.
- B. Pump performance and motor characteristics shall be such that motor will not be loaded beyond its service factor if operating head is reduced to 40% of specified head.

1.6 SUBMITTALS

- A. Product Data: Submit manufacturer's pump specifications, installation and start-up instructions, and current accurate pump characteristic performance curves with selection points clearly indicated.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.

- C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to HVAC pumps. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

## **PART 2 PRODUCTS**

### **2.1 SEWAGE PUMPS**

- A. Sewage pumps shall be centrifugal, direct connected type, simplex or duplex as scheduled.
- B. Casing shall be cast iron volute with radial clearance around impeller.
- C. Impeller shall be bronze or cast iron, non-clogging semi-open, keyed to corrosion-resistant alloy steel shaft.
- D. Pump equipped with cast iron pedestal support, registered and dowelled with inspection openings on cast iron sub-cover plate, bolted to steel cover plate with gas tight gaskets.
- E. Bearings shall be forced grease-lubricated bronze sleeve-type located every 6 feet (1.83 m) and forced grease-lubricated ball thrust above.
- F. Pump to be equipped with a flexible coupling, float switch on simplex units, dual float switches and mechanical alternator on duplex units, and a separate high level alarm float switch.
- G. Finish
  - 1. Pumps shall be thoroughly cleaned and painted with machine enamel prior to shipment.
  - 2. Finish marred during installation shall be touched up.

### **2.2 SUBMERSIBLE SEWAGE PUMPS**

- A. Pumps shall be submersible type, with bronze impeller, 303 stainless steel shaft, grease-lubricated sealed ball bearings, mechanical seal, cast iron strainer, 1750 RPM motor with built-in overload protection, micro pressure switch control, test button and 10'-0" three conductor cord with grounded plug.
- B. Finish
  - 1. Pumps shall be thoroughly cleaned and painted with machine enamel prior to shipment.
  - 2. Finish marred during installation shall be touched up.

### **2.3 SEWAGE PUMP BASINS AND COVERS**

- A. Description: Factory fabricated basin with sump, pipe connections, and separate cover.
- B. Sump: Fabricate watertight, with sidewall openings for pipe connections.
  - 1. Material: Cast iron or fiberglass.
  - 2. Reinforcement: Mounting plates for pumps, fittings and accessories.
  - 3. Anchor Flange: Same material as or compatible with sump, cast in or attached to sump, in location and of size required to anchor basin in concrete slab.
- C. Cover: Fabricate with openings having gaskets, seals, and bushings; for access to pumps, pump shafts, control rods, discharge piping, vent connections, and power cables.
  - 1. Material: Cast iron, Cast iron or steel with bituminous coating, or Steel with bituminous coating.
  - 2. Material: Steel with epoxy coating.

3. Reinforcement: Steel or cast iron, capable of supporting foot traffic for basins installed in foot-traffic areas.
- D. Capacities and Characteristics:
1. Refer to Drawings and Schedules

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- A. Examine roughing-in for plumbing piping to verify actual locations of sanitary drainage and vent piping connections before sewage pump installation.
- B. For Sewer Ejector Pumps:
  1. Verify exact requirements of basin depth. Set basin so bottom is at least 2'-6" below lowest pipe inlet invert.
  2. Set basin to avoid footings, underground piping and conduit. Verify floor elevation and set basin so top is flush with floor.
  3. Provide GFCI receptacle for 120V units.

### **3.2 INSTALLATION**

- A. Install pumps and arrange to provide access for maintenance including removal of motors, impellers, couplings, and accessories.
- B. Suspend wet-pit-mounted, vertical sewage pumps from basin covers. Make direct connections to sanitary drainage piping.
- C. Set submersible sewage pumps on basin floors. Make direct connections to sanitary drainage piping.
  1. Anchor guide-rail supports to basin bottoms and sidewalls or covers. Install pumps so pump and discharge pipe disconnecting flanges make positive seals when pumps are lowered into place.
- D. Install sewage pump basins and connect to drainage and vent piping. Brace interior of basins according to manufacturer's written instructions to prevent distortion or collapse during concrete placement. Set basin cover and fasten to basin top flange. Install cover so top surface is flush with finished floor.
- E. Install packaged, submersible sewage pump units and make direct connections to drainage and vent piping.
- F. Support piping so weight of piping is not supported by pumps.

### **3.3 CONNECTIONS**

- A. Install piping adjacent to sewage pumps to allow service and maintenance.
- B. Connect sanitary drainage and vent piping to pumps. Install discharge piping equal to or greater than size of pump discharge piping. Install vent piping equal to or greater than size of pump basin vent connection. Refer to Division 22 Section "Sanitary Drainage and Vent Piping".
  1. Install flexible connectors adjacent to pumps in discharge piping.

2. Install check and shutoff valves on discharge piping from each pump. Install unions on pumps having threaded pipe connections. Install valves same size as connected piping. Refer to Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty valves for sanitary waste piping.

#### 3.4 START-UP ASSISTANCE

- A. The manufacturer shall provide start-up assistance in the form of a factory trained service technician.

**END OF SECTION 22 1329**

SECTION 22 14 13  
FACILITY STORM DRAINAGE PIPING

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Provide equipment, materials, tools, labor, and supervision necessary to furnish, fabricate, and install a complete storm drainage piping system.

1.2 CODES AND STANDARDS

- A. Pipe materials specified in this Section shall apply to other technical sections of Division 22 of the Project Manual where applicable. Special requirements as may be called for in the technical sections, or shown on the Drawings, shall take precedence over General Requirements herein. Piping located in plenums shall be plenum-rated for fire and smoke.
- B. Local and/or State Plumbing, Mechanical and Building Codes
- C. Uniform Plumbing Code
- D. International Mechanical Code
- E. NFPA Codes and Standards

1.3 PRODUCT HANDLING

- A. Provide factory-applied plastic end-caps on each length of pipe and tube. Maintain end-caps through shipping, storage, and handling as required to prevent pipe-end damage and eliminate dirt and moisture from inside of pipe and tube.
- B. Where possible, store pipe and tube inside and protected from weather. Where necessary to store outside, elevate well above grade and enclose with durable, waterproof wrapping.
- C. Protect flanges and fittings from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

1.4 SUBMITTALS

- A. For each system served: Submit piping schedule listing, by range of sizes, piping material used.
- B. Submit product and performance data for equipment specified herein
- C. Locations of connections to existing sanitary sewer lines, storm water lines, and related invert elevations shall be submitted as a dimensioned drawing to the Owner's Representative or Architect/Engineer for construction record purposes.

**PART 2 PRODUCTS**

5.1 STORM WATER DRAINAGE PIPING MATERIALS

A. Piping:

| <b>MATERIAL</b>                                                            | <b>SERVICE</b>                                     |
|----------------------------------------------------------------------------|----------------------------------------------------|
| Cast iron soil pipe, service weight, bell and spigot, ASTM A74<br>Uncoated | Above ground downspouts 3" dia. and larger         |
| Solid wall Schedule 40 PVC pipe, ASTM D2665, (DWV) drain, waste and vent.  | Storm and downspouts inside building above ground. |

B. Fittings

1. Material and strength of fittings for cast storm sewer pipes, clay storm sewer pipes, and concrete storm sewer pipe shall conform to pipe as per ASTM Standards.
2. Ductile iron and grey Iron fittings - Class 250, ANSI/AWWA C110 A21.10, standard mechanical joint fitting with lugs for connecting to pipe.
3. Solid wall Schedule 40 PVC DWV - solvent cemented joints per ASTM D2665.

C. Joints

1. Cast iron bell and spigot soil pipe - pipe manufacturer's standard preformed, preset plastic or rubber joint, installed in accordance with manufacturer's instructions.
2. Threaded pipe - make joints using approved pipe joint compound, applied to male threads only. Cut pipe square, cut threads clean, remove burrs, and ream ends to full size of bore. Threads shall not be exposed on chromium-plated pipe.
3. Solid wall Schedule 40 PVC DWV - solvent cemented joints per ASTM D2665.

5.2 SLEEVES

- A. Sleeves passing through non-load bearing walls and partitions shall be galvanized sheet steel with lock seam joints of minimum gauges as follows: For pipes 2-1/2" in size and smaller - 24-gauge; 3 in. to 6 in. - 22-gauge; over 6 in. - 20-gauge.
- B. Sleeves passing through load bearing walls, concrete beams, fireproof walls, foundations, footings, and waterproof floors shall be Schedule 40 galvanized steel pipe or cast-iron pipe.
- C. Sleeves for insulated piping shall be of sufficient internal diameter to take pipe and insulation and to allow for free movement of pipe. Waterproof sleeves shall be of sufficient internal diameter to take pipe and waterproofing material.
- D. In finished areas where pipes are exposed, sleeves shall be terminated flush with wall, partitions and ceilings, and shall extend 1/2 in. above finished floors. Extend sleeves 1 in. above finished floors in areas likely to entrap water and fill space between sleeves and pipe with graphite packing and caulking compound.
- E. Sleeves passing through membrane waterproofing or roofing shall be flashed and sealed.



### 5.3 PIPE ESCUTCHEONS

- A. Provide pipe escutcheons with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extensions, if any. Furnish pipe escutcheons with chrome finish for occupied areas, prime paint finish for unoccupied areas.
- B. Pipe Escutcheons for Moist Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide cast brass or sheet brass escutcheons, solid or split hinged.
- C. Pipe Escutcheons for Dry Areas: Provide sheet steel escutcheons, solid or split hinged.
- D. Manufacturer: Chicago Specialty; Producers Specialty; or Sanitary-Dash.

### 5.4 GUARDS

- A. Where exposed insulated piping extends through floor, provide sheet metal guard around insulation to extend up from floor 60 inches. Guard to be galvanized sheet steel not less than 26-gauge.

### 5.5 FIRE SAFING

- A. Metal piping and sleeves passing through floors, roof, partitions and fire walls, shall be provided with firestop by packing space between pipe and sleeve with UL listed non-sag and self-leveling fire safing insulation per manufacturer's instructions.
- B. Plastic piping passing through fire rated floors and fire rated walls shall be provided with firestop by providing intumescent wrap strip around the pipe, enclosed in steel collar attached to structure.
- C. Cracks, Voids, or Holes Up to 4" Diameter: Use non-sag or self-leveling putty or caulking, one-piece intumescent elastomer, non-corrosive to metal, compatible with synthetic cable jackets, and capable of expanding 10 times when exposed to flame or heat, UL listed.
- D. Openings 4" or Greater: Use sealing system capable of passing 3-hour fire test in accordance with ASTM E814, consisting of wall wrap or liner, partitions, and end caps capable of expanding when exposed to temperatures of 250 to 350oF (121 to 177oC), UL listed.
- E. Seal all holes or voids made by penetrations to ensure an effective barrier against smoke, fire, toxic and combustible gases.
- F. Unless protected, from possible loading or traffic, install firestopping materials in floors having void openings or four (4) inches or more to support the same floor load requirements.
- G. Manufacturer: Subject to compliance with requirements, provide non-sag and self-leveling fire barrier caulk, wrap/strip, moldable putty and sheet forms of one of the following:
  - 1. 3M Brand.
  - 2. Flame Stop.
  - 3. Dow Corning.
  - 4. Metacaulk.

### 5.6 MECHANICAL SLEEVE SEALS

- A. Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

B. Manufacturer: Thunderline.

## 5.7 INSULATION

A. Reference Specification Section 22 0700 for Insulation Requirements.

## PART 3 EXECUTION

### 6.1 INSTALLATION

- A. Install storm building drains as indicated and in accordance with Uniform Plumbing Code. Lay storm building drains beginning at low point of systems, true to grade and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install required gaskets in accordance with manufacturer's recommendations for use with lubricants, cements, and other special installation requirements. Clear interior of piping of dirt and other superfluous material as work progressed. Maintain swab or drag in line and pull past each joint as it is completed. Place plugs in ends of uncompleted piping at end of day or whenever work stops.
- B. Comply with the requirements of the appropriate Division 22 sections for installation of basic piping materials, including hangers, supports, and accessories.
- C. Install horizontal piping as high as possible without sags or humps. Grade drainage at uniform slopes of 1/4 in. per ft. where possible, but in no case less than 1/8 in. per foot.
- D. Install horizontal piping as high as possible without sags or humps so that proper grades can be maintained for drainage. Branch piping shall come off the tops of mains unless shown otherwise.
- E. Check piping for interference with other trades; avoid placing water pipes over electrical equipment.
- F. Where rough-ins are required for equipment furnished by others, verify exact rough-in dimensions with Owner or equipment supplier before roughing-in.
- G. Refer to Division 31 - Earthwork for excavating, trenching, and backfilling requirements.
- H. Contractor shall verify existing tie-in invert elevations of storm sewer piping prior to installation of new piping. Coordinate the site storm sewer tie-in invert elevation with the site utility contractor. Existing tie-in inverts that are discovered to be different from the information on the bid documents shall be reported to the General Contractor or Construction Manager and the Engineer immediately.

### 6.2 SLEEVES

- A. Install sleeves for piping passing through floors, roof, walls, concrete beams, and foundations.
- B. Install fire-proofing per manufacturer's written instructions.

### 6.3 ESCUTCHEONS

- A. Install escutcheons for pipes entering finished spaces.

### 6.4 MECHANICAL SLEEVE SEAL INSTALLATION

- A. Install mechanical sleeve seals at all pipe penetrations through foundations below grade.
- B. Loosely assemble rubber links around pipe and bolts and pressure plates located under each bolt head and nut. Push into sleeve and center. Tighten bolts until links have expanded to form watertight seal.

## 6.5 PIPE PENETRATIONS

- A. Penetrations shall be free of debris and dirt. Dam the penetration (when required) with an acceptable material. Apply firestop material to the penetration per manufacturer's installation instructions. Use a caulking gun, putty knife or other normal trade tools. Remove damming materials where necessary after cure. Clean up with Xylene.

## 6.6 FIRE SAFING

- A. Install fire safing at all penetrations through walls, floors, etc. per manufacturer's installation instructions as required to meet UL listing.

## 6.7 TESTING AND CLEANING

- A. Provide labor, materials, facilities, and administration required to conduct the tests required under this section. Tests which fail to meet the specified performance shall be retested at no expense to the Owner. Repair all defective installations.
- B. Flush out piping system with clean water before proceeding with required tests. Inspect each run of each system for completion of joints, supports, and accessory items.
- C. Testing shall be done in compliance with the Uniform Plumbing Code and to the satisfaction of the Authorities Having Jurisdiction.
- D. Hydraulic Water Testing:
  - 1. Hydraulically pressure test each section or segment of the soil, waste and vent system prior to backfilling, encasing, enclosing or otherwise preventing visual observation of the section or segment being tested or access to repair if needed.
  - 2. The system and all joints shall be tested with no less than 10 feet head of water pressure. Top of test standpipe to be filled with water shall be a minimum of 10 feet above the highest point of section being tested.
  - 3. The water shall be kept in the tested system or sub-section for not less than 15 minutes before inspection for leakage begins.
  - 4. All leaks shall be promptly repaired by replacing damaged or defective components with new parts and system shall be re-tested, repeating repair and re-testing steps as needed, without additional cost to the Owner, until system is certified tight and leak free.
- E. Pneumatic Air Pressure Testing:
  - 1. Plastic piping shall not be tested with air. Do not over pressurize the system beyond maximum rating.
  - 2. Pneumatically pressure test with air each section or segment of the soil, waste and vent system prior to backfilling, encasing, enclosing or otherwise preventing visual observation of the section or segment being tested or access to repair if needed.
  - 3. The system and all joints shall be tested using an air compressor and pressure gauge or manometer testing apparatus.
  - 4. Fill tested system with air to a uniform, stabilized gauge pressure of 5 PSI. The system shall be held at the test pressure without the addition of air for a period of not less than 15 minutes.
  - 5. All leaks shall be promptly repaired by replacing damaged or defective components with new parts and system shall be re-tested, repeating repair and re-testing steps as needed, without additional cost to the Owner, until system is certified tight and leak free.

**END OF SECTION 22 1413**

SECTION 22 14 23  
STORM DRAINAGE PIPING SPECIALTIES

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Provide equipment, materials, tools, labor, and supervision necessary to furnish, fabricate, and install a complete storm drainage piping system.

1.2 CODES AND STANDARDS

- A. Local and/or State Plumbing, Mechanical and Building Codes
- B. Uniform Plumbing Code
- C. International Mechanical Code
- D. NFPA Codes and Standards

1.3 SUMMARY

- A. This Section includes the following storm drainage piping specialties:
  - 1. Roof drains

1.4 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. FRP: Fiberglass-reinforced plastic.
- C. HDPE: High-density polyethylene plastic.
- D. PE: Polyethylene plastic.
- E. PP: Polypropylene plastic.
- F. PVC: Polyvinyl chloride plastic.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated, include rated capacities, operating characteristics, and accessories.
- B. Installation, Operations and Maintenance data. Include signed copies of certified testing results reports.

1.6 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

**PART 2 PRODUCTS**

2.1 ROOF DRAINS

- A. Roof drains, including overflow roof drains, shall be epoxy coated cast iron body with sizes, outlet connections and model numbers as scheduled on Drawings and furnished by this Contractor.

- B. All piping connections thereto furnished and installed by this Contractor; flashing to be 4-pound lead and shall extend at least 12 in. onto roof in all directions from roof drain. Furnish with membrane flashing clamps.
- C. Coordinate roof drain installation with the General Contractor, Construction Manager, and Roofing Contractor.
- D. Domes shall be cast iron. No plastic or polyethylene domes shall be acceptable.
- E. Extension shall be height as required to allow for proper flow into the drain. Furnish 2-inch water dams for overflow roof drains.

### **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 wood-blocking reinforcement for wall-mounting-type specialties.
- C. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

#### **3.2 FIRE SAFING**

- A. Install fire safing at all penetrations through walls, floors, etc. per manufacturer's installation instructions as required to meet UL listing.

#### **3.3 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

#### **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 22 1423**

SECTION 22 34 00  
FUEL-FIRED DOMESTIC WATER HEATERS

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Provide materials, equipment, tools, labor and supervision necessary to install fuel-fired domestic water Heaters as required by the Drawings and this Section.

1.2 CODES AND STANDARDS

- A. ASHRAE/ANSI/IES 90.1 - Energy Efficiency for Buildings Except Low-Rise Residential Buildings
- B. IECC - International Energy Conservation Code
- C. ASME Boiler and Pressure Vessel Code
- D. NFPA/NEC 70 - National Electrical Code
- E. UPC - Uniform Plumbing Code
- F. IMC - International Mechanical Code
- G. Local and/or State Plumbing, Mechanical and Building Codes
- H. NFPA Codes and Standards
- I. IAPMO, NSF and U.L. Listed
- J. CSA International
- K. Any product used for dispensing potable water shall meet NSF 61 and NSF 372 testing standards. Third party testing shall be required.

1.3 SUBMITTALS

- A. Product Data: Submit product, dimensional, efficiency and performance data.
- B. Installation, Operations and Maintenance data.

**PART 2 PRODUCTS**

2.1 DOMESTIC STORAGE TANK WATER HEATERS - GAS-FIRED HIGH EFFICIENCY

- A. General:
  - 1. Water heater performance shall be as scheduled on Drawings. Refer to schedule for energy efficiency factors, first hour ratings, recovery ratings, and storage capacity information. Water heaters must meet or exceed current Energy Code requirements.
  - 2. Tank: Steel, seamless, self-cleaning, glass lined, vermin-proof, glass fiber insulation, Outer jacket shall be baked enamel finish. 150 PSI working pressure.
    - a. Piping Connections: Top and Bottom. Refer to Drawing details and Schedules for piping connection sizes and configurations.
    - b. Brass drain valve with capped hose end connection.
    - c. Manual Gas Cock.

- d. Anodes: Multiple, powered for cathodic protection.
  - e. ASME rated T&P relief valve
  - f. CSA certified
  - g. U.L. Listed
3. Heat Exchanger and Burner:
- a. Burner: Modulating, low-NOx, stainless steel, down-fired type.
  - b. Direct spark ignition, silicone nitride hot surface ignitor, with flame fail detection.
  - c. Natural gas 97% thermal efficiency rating.
  - d. Heat Exchanger: Centrally located, spiral type.
  - e. Max Temperature Setting: 181 deg F
- B. Venting: Power direct vent. Refer to Drawings and Manufacturer recommendations for vent sizing and material requirements.
- C. Electrical and Controls:
- 1. Power: 120-volt, single phase
  - 2. Provide electrical junction box with terminal block for wiring connections.
  - 3. Furnish with High temperature limit control with manual reset, upper and lower thermostats, low water cutoff and combination temperature-pressure gauge.
- D. Warranty: 3-year tank corrosion protection and 1-year limited parts warranty.
- E. Manufacturers: Subject to compliance with requirements, provide equipment by one of the following:
- 1. A.O Smith
  - 2. State
  - 3. Lochinvar
  - 4. Rudd
  - 5. Patterson Kelly
  - 6. Engineer approved equivalent
- F. Drain Pan: Furnish corrosion resistant, watertight drain pan with 3/4-inch min. sized drain piping beneath water heaters. Route pan discharge to adjacent floor drain.
- G. Condensate Neutralization Tanks:
- 1. Manufacturers:
    - a. JJM Boiler Works.
    - b. Engineer approved equivalent.
  - 2. General:
    - a. Condensate neutralization tanks for condensing fuel-fired appliance and flue pipe condensate drainage. Includes inspection and or cleanout caps. Furnish at least one (1) dedicated neutralization tank for each piece of equipment served.
    - b. Corrosion resistant PVC material.
    - c. Clear inline tubing for visual inspection.

3. pH Treatment Media: Magnesium oxide or Mfg. Recommended. Fill and pre-charge all units before placing into service.
4. Capacity Ratings:
  - a. Sizing shall be based on equipment served input firing rating, treatment media, required retainage (soak) time and condensate discharge pH. Sizing and quantity shall be per gas-fired equipment vendor's recommendations.
  - b. Minimum discharge pH: 6.0
5. Furnish sufficient additional pH treatment materials for 2 complete tank recharges.

## 2.2 EXPANSION - COMPRESSION TANKS

- A. Description: Steel, 150 psig max. pressure and 200-degree F max. temperature rated tank constructed with welded joints and factory installed butyl rubber diaphragm and rigid, mechanically bonded polypropylene liner.
- B. Construction:
  1. Tappings: Factory fabricated stainless steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe threads.
  2. Interior Finish: NSF 61 compliant barrier materials for potable water systems including fittings and outlets. All wetted components shall be of FDA approved materials.
  3. Air Charging Valve: Factory installed, Schrader valve for field charging.
- C. Capacity and Characteristics:
  1. Tank Capacity: Refer to Drawings and Schedules.
  2. Air Pre-charge Pressure: 55 psi. Field adjust to system operating pressure.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install according to manufacturer's recommendation.
- B. Make hot and cold-water piping connections including thermal checks.
- C. Route T & P relief valve piping to within 6 inches of floor.
- D. Unit shall be provided with a condensate trap drain fitting for the exhaust chamber. From condensate trap, route 5/8" ID hose to 1-1/2" diameter PVC condensate drain line to neutralization tank then to nearest floor drain. Do not discharge corrosive condensate onto floor surfaces.
- E. Furnish and install on concrete housekeeping pads. Pads shall be a minimum of 4" in height.
- F. Coordinate and field verify all water heater installation and service clearance requirements.
- G. Furnish drain pans in any areas subject to damage.
- H. Condensate neutralization tanks:
  1. Install per manufacturer's recommendations.
  2. Fill and pre-charge all condensate neutralization units before placing into service.
  3. Furnish adequate trap devices to prevent release of flue gasses into occupied spaces. Do not route flue gasses thru neutralization tanks.
  4. Route tank discharge to adjacent floor drain and terminate so discharge is clearly visible.



5. Test condensate discharge pH with equipment served at all potential firing rates. Furnish certified test results as part of gas fired equipment start up documentation.

**END OF SECTION 22 3400**

SECTION 22 40 00  
PLUMBING FIXTURES

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Provide fixtures, trim, accessories, labor, tools and supervision necessary to furnish and install plumbing fixtures as required by the drawings and this Section.

1.2 FIXTURE SCHEDULE

- A. Fixtures, trim, and accessories shall be of type and model numbers as scheduled on the drawings.

1.3 CODES AND STANDARDS

- A. IBC - International Building Code
- B. UPC - Uniform Plumbing Code
- C. PDI Compliance: Comply with standards established by PDI pertaining to plumbing fixture supports.
- D. ADA Compliance: Construct and install barrier-free plumbing fixtures in accordance with ADA and ANSI A117.1 requirements.
- E. Local and/or State Plumbing, Mechanical and Building Codes
- F. NFPA Codes and Standards
- G. IAPMO, NSF and U.L.
- H. Any product used for dispensing potable water shall meet NSF 61 and NSF 372 testing standards. Third party testing shall be required.

1.4 SUBMITTALS

- A. Submit Product Data which shall include product description, manufacturer, model, dimensions, size, rough-in requirements, connections to other equipment, construction materials and finishes, trim, accessory schedule, and performance data for each type of fixture.
- B. Submit manufacturers Installation Operation and Maintenance instructions. Include signed copies of certified testing reports.
- C. Submit to the General Contractor, cut-out trim plate for sinks which are to be installed in counter tops.

**PART 2 PRODUCTS AND QUALIFICATIONS**

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products manufactured by one of the following, as listed for each type of fixture, or an Engineer-approved equivalent:
  - 1. Vitreous China Fixtures: American Standard, Crane, Kohler, Eljer, and Zurn.
  - 2. Water Closet and Urinal Flush Valves: Sloan or Zurn
  - 3. Trim: Chicago Faucets, Delta Commercial, T&S Brass Works, or Sloan
  - 4. Water Coolers: Elkay, Halsey Taylor, or Oasis

5. Shower Valves: Chicago Faucets, Delta Commercial, Sloan, or Bradley
6. Fixture Carriers: Zurn, Wade, Josam, or J.R Smith
7. Toilet Seats: Bemis, Church, or Olsonite

## 2.2 VITREOUS FIXTURES

- A. Vitreousware shall be non-absorbent, even color, un-warped, two-fired vitreous china, grade A as rated by the Bureau of Standards.
- B. Enameled cast iron fixtures shall have the enamel fused with the iron to provide a hard acid-resisting enameled finish.
- C. Vitreous fixtures shall be white, except where other colors are called for in schedule.
- D. Bathtubs shall have slip-resistant surface.

## 2.3 FLUSH VALVES

- A. Flush valves for handicapped fixtures shall be installed in compliance with ADA requirements and shall be installed with flush valve control mounted on wide side of toilet.
- B. Flush valves shall be installed with angle stop and vacuum breaker.

## 2.4 TRIM

- A. Trim shall include: Supply pipes, stop valves, faucets, tail pieces, strainers, wastes, traps, and floor and wall escutcheon plates which shall be brass. Exposed trim shall be chrome-plated.
- B. Stop valves shall be compression type with loose key handle control.
- C. P-traps shall be chrome-plated, adjustable cast brass with cleanout plug.
- D. Faucets shall contain standardized interchangeable operating units for both hand-closing and self-closing types, closing with the pressure of the water and containing a stamped Monel metal seat.

## 2.5 ELECTRIC WATER COOLERS

- A. Refer to Drawings and Schedules.
- B. Furnish one-piece silver impregnated charcoal, NSF approved, inline water filter for all electric water coolers. Furnish an additional filter element for each Electric Water Cooler installed.

## 2.6 SHOWER VALVES

- A. Shower valves shall be mixing valve type, pressure balancing, with integral stops. Refer to Plumbing Fixture Schedule on Drawings for manufacturer and model numbers.

## 2.7 AERATORS

- A. Provide aerators of types approved by Health Departments having jurisdiction. Maximum flow to be 0.5 gpm in compliance with Energy Policy Act of 2005 and ASME/ANSI Standard A112.18.1M provide restrictive aerator as required.
- B. Comply with additional fixture requirements contained in fixture Schedule as shown on Drawings.

## 2.8 FIXTURE CARRIERS

- A. Provide cast-iron supports for fixtures of graphitic gray iron, ductile iron, or malleable iron as indicated. Provide floor mounted carriers for wall mounted fixtures.

## 2.9 FIXTURE BOLT CAPS

- A. Provide manufacturer's standard exposed fixture bolt caps finished to match fixture finish.

## 2.10 ESCUTCHEONS

- A. Where fixture supplies and drains penetrate walls in exposed locations and within cabinetry, provide chrome plated sheet steel escutcheons with friction clips.

# PART 3 EXECUTION

## 3.1 INSPECTION

- A. Examine roughing-in work of potable water and waste piping systems to verify actual locations of piping connections prior to installing fixtures. Also examine floors and substrates, and conditions under which fixture work is to be accomplished. Correct any incorrect locations of piping, and other unsatisfactory conditions for installation of plumbing fixtures. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

## 3.2 INSTALLATION

- A. General: Install plumbing fixtures of types indicated where shown and at indicated heights; in accordance with fixture manufacturer's written instructions, roughing-in drawings, and with recognized industry practices. Ensure that plumbing fixtures comply with requirements of the Uniform Plumbing Code and Americans with Disability Act (ADA) Standards for Accessible Design pertaining to installation of plumbing fixtures.
- B. Fasten plumbing fixtures securely to indicated supports or building structure and ensure that fixtures are level and plumb. Secure plumbing supplies behind or within wall construction so as to be rigid, and not subject to pull or push movement.
- C. Install fixtures and make water supply, waste, and vent connections as indicated on drawings.
- D. Set fixtures in center of stalls, between partitions where required. Dimensions for spacing shall be verified.
- E. Setting shall be absolutely tight and rigid on proper ground. All fixtures shall be sealed to structures (walls, floors, etc.) with non-mildew silicone caulk.
- F. Fixtures shall be covered with paper glued in place after they are set to prevent damage during the balance of construction, at the conclusion of work the paper shall be removed and the fixtures properly cleaned.
- G. The Contractor shall be responsible for the protection of the fixtures until acceptance by the Owner. Damaged fixtures shall be replaced at no additional cost to the Owner.
- H. All fixtures and accessories for handicapped use shall be installed in compliance with ADA requirements.
- I. Countertop mounted stainless steel sinks shall be installed using a compression style clip and bolt mount. Snap ring installations shall NOT be permitted.

## 3.3 FIELD QUALITY CONTROL

- A. Upon completion of installation of plumbing fixtures and after units are water pressurized, test fixtures to demonstrate capability and compliance with requirements. When possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.

- B. Inspect each installed unit for damage to finish. If feasible, restore and match finish to original at site; otherwise, remove fixture and replace with new unit. Feasibility and match to be judged by Architect/Engineer. Remove cracked or dented units and replace with new units.

#### 3.4 ADJUSTING AND CLEANING

- A. Clean plumbing fixtures, trim, and strainers of dirt and debris upon completion of installation.
- B. Adjust water pressure at drinking fountains, faucets, shower valves, and flush valves to provide proper flow stream and specified gpm.
- C. Adjust or replace washers to prevent leaks at faucets and stops.

**END OF SECTION 22 4000**

SECTION 23 05 00  
COMMON WORK RESULTS FOR HVAC

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. The work shall include the furnishings of systems, equipment and materials specified in this Division and as called for on the Mechanical Drawings to include supervision, quality control, operation, methods and labor for the fabrication, installation, start-up and tests for the complete mechanical installation. The work shall also include the furnishing of necessary hoisting facilities to set materials and equipment in place and the furnishing of any scaffolding and transportation associated with this work.
- B. Examine the project site and become familiar with existing conditions which will affect the work. Review the drawings and specifications of other trades and take note of conditions to be created which will affect the work. All conditions shall be considered in the preparation of bids; no additional compensation will be made on the behalf of this Contractor.
- C. Provide labor necessary to demolish the existing mechanical system as shown on the drawings, as described in Part 3, Existing Conditions, or as required.
- D. Where noted on the drawings or where called for in other sections of the specification, the Contractor for this division shall install equipment furnished by others, and shall make required service connections. Verify with the supplier of the equipment the requirements for the installation. This contractor shall be responsible for the removal and installation of railings, piping, ductwork, louvers, etc. as required to install new equipment. Coordinate shipping splits for all equipment provided by this contractor.

1.2 DAMAGE

- A. The Contractor shall be responsible for damage to the work of other trades or to the building and its contents, caused by equipment installation.

1.3 PERMITS AND INSPECTIONS

- A. Obtain and furnish necessary permits and inspection certificates for material and labor furnished. Permits and certificates shall be obtained from the proper inspection authorities. The cost of permits, certificates and fees required in connection with the installation shall be borne by the Contractor, unless otherwise noted in the detailed contractual description preceding these specifications. Where applications are required for the procuring of utility services to the building, see that such application is properly filed with the utility, and that information required for such an application is presented to the extent and in the form required by the utility company.

1.4 CODES AND STANDARDS

- A. Applicable provisions of the following codes and standards are hereby imposed on a general basis for the mechanical work (in addition to specific applications specified by individual work sections of these specifications):
  - 1. ASHRAE/IES 90.1 - 2010 Code for Energy Efficiency
  - 2. ANSI Pressure Piping Standards (B31)
  - 3. AWWA Standards
  - 4. American Gas Association
  - 5. AWS Standards for Welding

6. National Electrical Code
  7. Local and/or State Plumbing, Mechanical and Building Codes
  8. Occupational Safety and Health Act (OSHA)
  9. International Energy Conservation Code 2012
  10. Uniform Plumbing Code
  11. International Mechanical Code
  12. NFPA Standards and Pamphlets
- B. If any work indicated on the drawings or specified herein conflicts in any way with any of the rules and regulations of the above authorities, the Contractor shall notify the Architect/Engineer in writing 72 hours before bids are opened. In the event the Contractor fails to notify the Architect/Engineer and changes are required by said conflicts, the Contractor shall make such changes as are required without additional cost to this Owner.
- C. Installations must be safe in every respect and must not create a condition which will be harmful to building occupants; to operating, installing or testing personnel; to workmen; or to the public. The contractor for each installation shall be solely responsible for providing installations which will meet these conditions. If the Contractor believes that the installation will not be safe for all parties, report these beliefs in writing to the Architect/Engineer before any equipment is purchased or work is installed, giving recommendations. The Architect/Engineer will work out required changes and adjustments in contract price where adjustments are warranted.

#### 1.5 DRAWINGS

- A. A complete set of drawings including civil, architectural, structural, mechanical, and electrical drawings shall be on the site at all times. Prior to installing any of the work, check the drawings for dimensions and see that the work does not interfere with clearance required for ceilings, beams, foundations, finished columns, pilasters, partitions and electrical equipment as shown on the drawings and details. After work is installed and it develops that interferences occur which have not been called to the Architect/Engineer's attention before the installation, the Contractor shall, at his own expense, make such changes in his work as directed by the Architect/Engineer.
- B. The contract drawings for mechanical work are in part diagrammatic, intended to convey the scope of work and indicate general arrangement and approximate sizes and locations of equipment and materials. Where job conditions require reasonable changes in indicated locations and arrangement, the Contractor shall make such changes as directed by the Architect/Engineer, without additional cost to the Owner.
- C. Because of the scale of the drawings, certain basic items such as pipe fittings, access panels, and sleeves may not be shown; but where such items are required by other sections of these specifications or where they are required by the nature of the work, they shall be furnished and installed. Rough-in dimensions and locations shall be verified with the supplier of equipment furnished by other trades, or by the Owner, prior to the time of roughing-in.
- D. Equipment specification may not deal individually with minute items required such as components, parts, controls and devices which may be required to produce the equipment performance specified, or as required to meet the equipment warranties. Where such items are required, they shall be included by the supplier of the equipment, whether or not specifically called for.

- E. The drawings and the specifications are cooperative and supplementary. It is the intent of both said drawings and specifications to cover all mechanical requirements in their entirety as nearly as possible. The Contractor shall closely check the drawings and specifications for any obvious errors or omissions and bring any such condition to the attention of the Architect/Engineer prior to the receipt of bids, in order to permit clarification by means of a mailed Addendum. If there is no question prior to the bid proposal date, the Architect/Engineer shall assume that the drawings and specifications are complete and correct and will expect the intent of said documents to be complied with, and the installation to be complete in all respects, according to said intent.
- F. Locate equipment which must be serviced, operated or maintained in fully accessible positions. Minor deviations from the contract drawings may be made to allow for better accessibility, but changes of magnitude, or which involve extra cost, shall not be made without prior approval. Ample space shall be allowed for removal of parts that may require replacement or service in the future.

## 1.6 RESPONSIBILITY

- A. The Contractor's responsibility shall not end with the installation and connecting of the various apparatus. It shall include the services of an experienced superintendent, who shall be constantly in charge of the work, together with the qualified journeymen, helpers and laborers required to properly unload, install, connect, adjust, start, operate and test the work involved, including equipment and materials furnished by other trades or by the Owner, until such time as the entire mechanical installation functions properly in every detail.

## 1.7 COORDINATION

- A. Coordinate the work with other trades prior to installation.
- B. No piping, ducts or equipment foreign to the electrical equipment or architectural appurtenances shall be run over the top of any electrical panels or electrical equipment, in accordance with NEC 110-16 and 384-4. This does not prohibit sprinkler protection for the installation.
- C. The determination of quantities of material and equipment required shall be made from the drawings. Schedules on the drawings and in the specifications are completed as an aid, but where discrepancies arise, it shall be the Contractor's responsibility to provide the required quantity.
- D. Where the specifications state that equipment shall be furnished, installed or provided, it shall be understood to mean this Contractor shall furnish and install completely, unless it is specifically stated that the equipment is to be furnished and installed by others.
- E. The Architect/Engineer reserves the right to determine space priority of the contractors in the event of interference between the piping and equipment of the various contractors. Conflicts between the drawings and specifications, or between requirements set forth for the various trades, shall be called to the attention of the Architect/Engineer. If clarification is not asked for prior to the taking of bids, it will be assumed that none is required, and that the Contractor has submitted his bid in conformance with plans and specifications as issued and that no interference exists.
- F. No piping, ducts or equipment foreign to an elevator hoistway and machine room shall be run inside the hoistway and machine room in accordance with NEC 620-37 and ASME A17.1, 102.2.

## 1.8 GUARANTEE AND MAINTENANCE

- A. Materials and equipment shall be guaranteed to be free from defects and to be new equipment; no secondhand, used or salvaged equipment will be allowed.



- B. Keep the entire portion of the work in repair, without additional cost to the Owner, so far as defects in workmanship, apparatus, material or construction are concerned for one (1) year from the date of final acceptance, except as otherwise specified herein.
- C. Equipment, which fails to meet performance ratings as specified and shown on the drawings, shall be removed and replaced by new equipment that meets the specified requirements, without additional cost to the Owner.
- D. Materials and workmanship shall be subject to the review of the Architect/Engineer, in whose presence various tests shall be made as required by these specifications.

## **PART 2 PRODUCTS**

### **2.1 SUBMITTAL PROCESS**

- A. Submit shop drawings and catalog data for mechanical equipment specified in Division 23 in accordance with Division 01.
- B. Submittal data for mechanical equipment shall consist of shop drawings and/or catalog cuts showing technical data necessary to evaluate the material or equipment to include dimensions, wiring diagrams, performance curves, rating, control sequence, and other descriptive data necessary to describe fully the item proposed and its operating characteristics. Shop drawings shall be submitted on equipment and materials as required by the specifications.
- C. Approval of materials, including alternate or substitute items, shall be obtained in writing from the Architect/Engineer, verbal approval will not be considered binding.
- D. Shop drawings shall be submitted and shall have been signed, checked, approved, and initialed by the Contractor prior to submittal to the Architect/Engineer. The Architect/Engineer will review shop drawings to aid in interpreting the plans and specifications and will in so doing assume that the shop drawings conform to specified requirements set forth in this specification. The approval of the shop drawing by the Architect/Engineer does not relieve the Contractor of the responsibility of complying with elements of the specification. The name of the job, Architect/Engineer, location, and specification section shall appear on all pages of shop drawings. Equipment marks (such as EF-1, RTU-1) shall be indicated for each item.
- E. At the completion of the job, furnish three (3) copies of parts lists, operating and maintenance instructions, and manuals organized and bound, in three books.
- F. At the completion of the project, prepare and submit to the Owner record drawings showing the location of piping and ductwork. Drawing shall give accurate dimensions of such equipment for future use by the Owner. This drawing shall be submitted as soon as work is completed and before authorization of final payment.

### **2.2 SUBCONTRACTORS AND MATERIALS**

- A. Submit to the Architect/Engineer for review, when requested, a list of subcontractors, materials and equipment proposed to be used. The list must be reviewed by the Architect/Engineer before this Contractor may enter into any subcontractual agreement. Equipment, materials, and devices, etc. shall be subject to the review of the Architect/Engineer, whether or not said items are herein specified.

### **2.3 STANDARDS OF MATERIALS AND WORKMANSHIP**

- A. Materials shall be new, complete with manufacturer's guarantee or warranty, and shall be as listed by Underwriters Laboratories (UL), Inc., Air Movement and Control Association (AMCA), American Gas Association (AGA), Air Conditioning and Refrigeration Institute (ARI), etc., if a standard has been established by that agency for the type of material.

- B. Materials shall also comply with applicable standards of the National Electrical Manufacturer's Association, National Board of Fire Underwriters, National Fire Protection Association, National Safety Council, National Bureau of Standards, the National Electrical Code and the Williams-Steiger Occupational Safety and Health Act of 1970. Such standards are hereby made a part of these specifications.
- C. Work shall be performed by workmen skilled in the particular craft, shall be executed in a workmanlike manner, and shall present a neat mechanical appearance when completed. Align, level and adjust equipment for satisfactory operation, and install so that connecting and disconnecting of piping and accessories can be made readily and so that parts are easily accessible for inspection, operation and maintenance. Methods and techniques of installation shall be subject to the review of the Architect/Engineer.
- D. Materials shall be the standard product of a reputable manufacturer regularly engaged in the manufacture of the specific product. Materials of the same type of class shall be the products of one manufacturer. For example, fans shall be from the same manufacturer and pumps from the same manufacturer.
- E. Materials shall be protected from damage and stored indoors or protected from the weather at all times, unless other storage arrangements are approved by the Architect/Engineer.
- F. Bearing lubrication fittings shall be as recommended by the manufacturer and shall be extended, where necessary, to an accessible location.
- G. Material and equipment shall be installed in strict accordance with the manufacturer's recommendations.

#### 2.4 MATERIAL SUBSTITUTIONS

- A. Proposals as submitted shall be based on the products specifically named in the specification or on the drawings. Material or equipment by manufacturers other than those specified may be used only by permission of the Architect/Engineer. Such permission for substitution must be requested, in writing in accordance with Division 01.
- B. The Architect/Engineer reserves the sole right for the approval of proposed material or equipment, and the phrase, "or approved equivalent", used in these specifications, or on the drawings, shall be interpreted to mean an equivalent approved by the Architect/Engineer.
- C. Changes required by alternate equipment shall be made at no additional cost to the Owner; and costs incurred by other trades, public utilities or the Owner, as a result of the use of such equipment, shall be the responsibility of the Contractor.
- D. Furnish to the Architect/Engineer, when requested, samples of proposed material or equipment substitutions. These samples shall remain with the Architect/Engineer as long as needed.
- E. Identify the differences in alternate material or equipment as compared to that specified and indicate the benefits to the project as a result of selecting the alternative.
- F. The Architect/Engineer reserves the right to refuse approval of equipment which does not meet the specification, in their opinion, or of equipment for which no local experience of satisfactory service is available. The Architect/Engineer further reserves the right to reject equipment for which maintenance service and the availability of replacement parts is questionable.

## **PART 3 EXECUTION**

### **3.1 EXISTING CONDITIONS**

- A. Examine the existing buildings and grounds and become familiar with the conditions as they exist, or that will in any manner affect the work under this contract. No allowance will be made subsequently, in this connection, on behalf of the Contractor for any error or negligence by the Contractor.
- B. Existing equipment, such as duct or pipe, in or on the existing building and grounds which is to be replaced, or which interferes in any way with the remodeling of the existing facilities and/or installation of new equipment, shall be removed from the premises or relocated by this Contractor, as directed by the Architect/Engineer. Do not remove from the premises, any equipment that may have maintenance value to the Owner without permission of the Owner. Equipment, duct or pipe not to be reused shall be removed from the premises, unless otherwise noted herein or shown on the drawings.
- C. Where existing equipment is removed or changed, all duct and pipe no longer in service shall be removed and stubs plugged as directed by the Architect/Engineer. Building surfaces damaged and openings left by removal of equipment shall be repaired by the proper trades and paid for by this Contractor, unless otherwise noted on the drawings. The cutting and fitting shall be done by this Contractor. The cutting of floor, ceiling or wall surfaces shall be done by this Contractor with extreme care, in order to avoid any disrupting or damage of existing utility services which may be encountered. Coordinate with other trades and with the General Contractor to minimize the damage to the building in order to reduce the amount of patching required.
- D. Where new openings are cut and concealed piping is encountered, such items shall be removed or relocated as required. Where systems to be removed stub through floors, walls or ceilings, openings shall be patched so that no evidence of the former installation remains.
- E. Existing active services (water, gas, sewer, electric), when encountered, shall be protected against damage. Do not prevent or disturb operation of active services that are to remain. If active services are encountered which require relocation, make request to authorities with jurisdiction for determination of procedures. Where existing services are to be abandoned, they shall be terminated in conformance with requirements of the utility or municipality having jurisdiction.
- F. The location, size and elevation of underground utilities shown on the drawings are in accordance with data supplied by the Owner and/or the various utility companies. The Contractor shall verify this data and shall report any discrepancies to the Architect/Engineer before submitting his bid.

### **3.2 INTERRUPTION OF SERVICE**

- A. Changes in service shall be made so as to provide a minimum of interference with the operation of services in the building. When changes require shutdown of building services, notify the proper building authorities no less than 24 hours in advance and obtain approval from these authorities before making changes. Such notices shall give duration and nature of shutdown. Temporary arrangements shall be approved by the Architect/Engineer and/or Owner.
- B. Any and all interruptions to building services shall be in accordance with Division 01.

### **3.3 OPENINGS, CUTTING, AND PATCHING**

- A. The General Contractor shall coordinate the placing of openings in the new structure, as required for the installation of the mechanical work.

- B. Furnish to the General Contractor the accurate locations and sizes for required openings. This shall not relieve this Contractor of the responsibility of checking to assure that proper size openings are provided. When additional patching is required due to this Contractor's failure to inspect this work, this Contractor shall make arrangements for the patching required to properly close the opening, to include patch painting. This Contractor shall pay any additional cost incurred in this respect.
- C. When cutting and patching of the structure is made necessary due to this Contractor's failure to install piping, ducts, sleeves or equipment on schedule, or due to this Contractor's failure to furnish, on schedule, the information required for the leaving of openings, it shall be this Contractor's responsibility to make arrangements for this cutting and patching. This Contractor shall pay any additional cost incurred in this respect.
- D. Provide cutting and patching and patch painting in the existing structure, as required for the installation of the work. Furnish lintels and supports as required for openings. Cutting of structural support members will not be permitted without prior approval of the Architect/Engineer. Extent of cutting shall be minimized. Use core drills, power saws or other machines which will provide neat, minimum openings. Patching shall match adjacent materials and surfaces and shall be performed by craftsmen skilled in the respective craft required.

### 3.4 EXCAVATION AND BACKFILL

- A. See Division 31 for requirements for trench excavation, backfill, and compaction.

### 3.5 CONCRETE AND MASONRY WORK

- A. Concrete work included herein or shown on the drawings shall be done only by experienced cement finishers. Brickwork, where included, shall be laid only by experienced brick masons. Brick shall be of uniform size, hard burned, and shall be laid in cement mortar, except for patch work at a location where cement and lime mortar has previously been used. Exposed, finish brickwork shall match existing brickwork as closely as practical and shall be to the satisfaction of the Architect/Engineer and Owner.
- B. Concrete bases and pads for mechanical equipment will be furnished by General Contractor. This Contractor shall coordinate size and location.
- C. Furnish equipment anchor bolts and be responsible for their proper installation and accurate location.

### 3.6 ROOF OPENINGS

- A. Roof openings required by this Contractor that are not shown on the Structural or Architectural Drawings shall be cut and (if necessary) reinforced by an experienced roofing contractor.
- B. Roof penetrations for duct and piping shall be through curbed roof openings. Equipment supports shall be by curbed and flashed runners meeting current National Roofing Contractor Association (NRCA) standards and details. Pitch pockets, pitch pans, and wood blocking are not acceptable.
- C. All roof work shall be completed such that it does not void any existing roof warranty.

### 3.7 PAINTING

- A. The finish of any item that has been marred, scratched or damaged in any way by this Contractor shall be repainted at the expense of this Contractor, and to the satisfaction of the Architect/Engineer and the Owner.
- B. Painting and finishing of exposed mechanical systems including piping and duct shall be as shown on the drawings and in DIVISION 09 - FINISHES.

### 3.8 CLEANING

- A. Keep the premises clean of all debris, caused by the work as described in DIVISION 01.
- B. At the conclusion of the construction, the site shall be thoroughly cleaned of all rubble, debris and unused material and shall be left in good order. Closed off spaces shall be cleaned of waste such as material, cartons, and wood frame members used in the construction.

### 3.9 WIRING FOR MECHANICAL EQUIPMENT

- A. The electrical contractor will provide power to and connection of motors and equipment furnished by this Contractor. Where disconnect switches are not specified to be furnished with the equipment, the electrical Contractor will furnish disconnect switches for equipment furnished by this Contractor.
- B. Provide integral wiring, alarm wiring, control wiring, temperature control wiring and interlock wiring for equipment furnished, whether or not such wiring is furnished by the equipment vendor.
- C. Except where other Sections call for starters to be furnished by manufacturers as part of their equipment, the electrical contractor will furnish motor starters for motors furnished by this Contractor.
- D. Furnish to the electrical contractor, shop drawings and a schedule for motors and other mechanical equipment furnished, which require electrical services. The schedule shall include the locations for rough-ins, electrical loads, size, and electrical characteristics for services required.
- E. Additional costs incurred, where motors or equipment furnished by this Contractor require larger services or services of different electrical characteristics than those called for on the Electrical Drawings, due to the Contractor furnishing substitute equipment, shall be paid for by this Contractor.
- F. Review the Electrical Drawings and call to the attention of the Architect/Engineer, prior to bidding, omissions of electrical services required for equipment.
- G. Mechanical equipment which requires fuse protection, to maintain UL listing, shall be coordinated with the electrical contractor to provide such protection.

### 3.10 MOTORS

- A. TEFC and ODP motors for equipment supplied by this contractor shall meet or exceed the listed values when tested in accordance with IEEE Standard 112 Method B as defined by NEMA Standard MG 1-12.6C. Efficiency values listed are based on NEMA Premium Efficiency Motors of NEMA MG 1-2003, Table 12-12 at 1800 RPM:

| HP  | ODP  | TEFC |
|-----|------|------|
| 1   | 85.5 | 85.5 |
| 1.5 | 86.5 | 86.5 |
| 2   | 86.5 | 86.5 |
| 3   | 89.5 | 89.5 |
| 5   | 89.5 | 89.5 |
| 7.5 | 91.0 | 91.7 |
| 10  | 91.7 | 91.7 |
| 15  | 93.0 | 92.4 |
| 20  | 93.0 | 93.0 |
| 25  | 93.6 | 93.6 |
| 30  | 94.1 | 93.6 |
| 40  | 94.1 | 94.1 |
| 50  | 94.5 | 94.5 |
| 60  | 95.0 | 95.0 |
| 75  | 95.0 | 95.4 |
| 100 | 95.4 | 95.4 |
| 125 | 95.4 | 95.4 |
| 150 | 95.8 | 95.0 |
| 200 | 95.8 | 95.0 |

- B. All motors that are indicated to be used with Variable Frequency Drives (VFDs) shall be inverter duty rated. Coordinate all motor requirements with the electrical contractor.

### 3.11 PROTECTION

- A. Special care shall be taken for the protection of equipment furnished by this Contractor. Equipment and material shall be protected from elements such as weather, painting and plastering until the project is completed. Damage from rust, paint or scratches shall be repaired as required to restore equipment to original condition.
- B. Protection of equipment during the plastering and painting of the building shall be the responsibility of the contractor performing that work, but this shall not relieve this Contractor of the responsibility of checking to assure that adequate protection is being provided.
- C. Where the installation or connection of equipment requires this Contractor to work in areas previously finished by other contractors, this Contractor shall be responsible that such areas are protected and are not marred, soiled or otherwise damaged during the course of such work. This Contractor shall arrange with the other contractors for repairing and refinishing of such areas which may be damaged.
- D. When heavy materials must be placed upon or transported over the roof deck, sheeting shall be placed to distribute the weight and support such materials. Any damage shall be immediately corrected at no cost to the Owner.

### 3.12 ASBESTOS IDENTIFICATION AND CONTROL

- A. In the event that suspected asbestos containing material (ACM) is encountered during the course of the work, cease operations in the immediate area and promptly notify the Architect/Engineer. Suspected materials will then be sampled and analyzed by the Owner. Should ACM be identified, the Owner's Representative will direct the procedures for abatement, either by subcontract to the Contractor or separate contractor. During abatement operations, cease operations in the immediate area of the abatement. Operations in other areas of the project may be performed, but care must be taken to control dust to avoid contamination of the abatement containment or air monitoring samples. The Contractor shall coordinate activities with the asbestos abatement contractor.
- B. Should no ACM be identified, operations may be resumed. Delays caused by identification, analysis or abatement may be added to the time of the contract, at the discretion of the Architect/Engineer by Change Order.

### 3.13 NOISE AND VIBRATION

- A. Be responsible for the installation of all equipment in such a manner as to control the transmission of noise and vibration from any installed equipment or system, so that the sound level does not exceed NC35 in any occupied space. Be responsible for the correction of any objectionable noise in any occupied area due to improperly installed equipment.

### 3.14 TESTS AND DEMONSTRATIONS

- A. Systems shall be tested and placed in proper working order prior to demonstrating systems to the Owner.
- B. Prior to acceptance of the mechanical installation, demonstrate to the Owner or his designated representatives essential features and functions of all systems installed, and instruct the Owner in the proper operation and maintenance of such systems.
- C. Furnish the necessary trained personnel to perform the demonstrations and instructions and arrange to have the manufacturer's representatives for the system present to assist with the demonstrations. The Owner and Contractor shall each sign a certification stating that the training has been performed and the Owner accepts same.

### 3.15 UTILITY REBATE APPLICATIONS

- A. This contractor shall be responsible for gathering information necessary for completing local utility rebate applications and submitting to the proper utility companies for gas and electric rebates. Potential rebates include high efficiency gas boilers, thermostats, timeclocks, motors, and other items furnished by this mechanical contractor.

**END OF SECTION 23 0500**

SECTION 23 05 29  
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Provide equipment, materials, labor and supervision necessary to install pipe hangers and supports.
- B. Pipe support systems shall secure pipes in place, prevent pipe vibration, provide vertical adjustment for maintaining required grades, and provide for expansion and contraction.
- C. Where supports are attached to concrete or other structural members, care shall be taken to prevent damage or weakening of the structural members.
- D. Where concrete inserts are to be used, it shall be this Contractor's responsibility to accurately locate and attach inserts to concrete forms.

1.2 REFERENCES

- A. American National Standards Institute, ANSI:
- B. ANSI B31.1: Power Piping
- C. Manufacturers Standardization Society of the Valve and Fittings Industry, MSS, 1815 North Fort Myer Drive, Arlington, VA 22209.
  - 1. MSS SP-58: Materials Standardization Society: Pipe Hangers and Supports-Materials, Design, and Manufacturer.
  - 2. MSS SP-69: Materials and Standardization Society: Pipe Hangers and Supports - Selection and Application.
  - 3. NFPA 13-Standard for the Installation of Sprinkler Systems.
  - 4. ASTM A123-Specification for Zinc Hot-Galvanized Coatings by the Hot Dip Process.
  - 5. ASTM A653 G90-Specification for Steel Sheet, Zinc on Iron and Steel.

1.3 SUBMITTALS

- A. Submit manufacturer's product data on all hangers and support devices. Product data to include, but not be limited to materials, finishes, approvals, load ratings, and dimensional information.

**PART 2 PRODUCTS**

2.1 HANGERS AND SUPPORTS

- A. Hangers and support devices shall be Anvil International Inc., Tolco, Fee and Mason, Michigan, B-Line or approved equivalent. Figure numbers based on Anvil.



**PART 3 EXECUTION**

**3.1 INSTALLATION - HORIZONTAL PIPE SUPPORTS**

- A. Hanger rods for steel, wrought iron and brass pipe shall be installed in accordance with MSS SP-69 Tables 3 and 4 and the following schedule:

| <b>Pipe Size</b>      | <b>Rod Diameter</b> | <b>Maximum Spacing</b> |
|-----------------------|---------------------|------------------------|
| Up to 1-1/4"          | 3/8"                | 7'-0"                  |
| 1-1/2" and 2"         | 3/8"                | 9'-0"                  |
| 2"                    | 3/8"                | 10'-0"                 |
| 2-1/2", 3" and 3-1/2" | 1/2"                | 10'-0"                 |
| 4" and 5"             | 5/8"                | 12'-0"                 |
| 6"                    | 3/4"                | 12'-0"                 |
| 8"                    | 7/8"                | 14'-0"                 |
| 10" and 12"           | 7/8"                | 16'-0"                 |
| 14" and 16"           | 1"                  | 16'-0"                 |
| 18"                   | 1-1/8"              | 18'-0"                 |
| 20" and 24"           | 1-1/4"              | 20'-0"                 |

- B. Hanger rods for copper pipe and tube shall be installed in accordance with MSS-SP-69 Tables 3 and 4 and the following schedule:

| <b>Pipe Size</b>  | <b>Rod Diameter</b> | <b>Maximum Spacing</b> |
|-------------------|---------------------|------------------------|
| 1/2" and 3/4"     | 3/8"                | 5'-0"                  |
| 1"                | 3/8"                | 6'-0"                  |
| 1-1/4"            | 3/8"                | 7'-0"                  |
| 1-1/2"            | 3/8"                | 8'-0"                  |
| 2"                | 3/8"                | 8'-0"                  |
| 2-1/2"            | 1/2"                | 9'-0"                  |
| 3", 3-1/2" and 4" | 1/2"                | 10'-0"                 |
| 5"                | 1/2"                | 13'-0"                 |
| 6"                | 5/8"                | 14'-0"                 |
| 8"                | 3/4"                | 16'-0"                 |

- C. Support horizontal cast iron soil pipe with two hangers for each pipe length. Locate hangers close to couplings.
- D. In addition to the above specified spacings, install additional hangers at change in pipe direction and at concentrated loads, large valves and strainers.
- E. Where more than one pipe is to be run parallel together, they may be supported on trapeze type hangers. Trapeze bar angles and hanger rods shall be of sufficient size to support the particular group of pipes. Trapeze hanger spacing shall be based on the smallest pipe on the rack. When hanging from light gauge metal trusses, coordinate pipe hanger spacing and hanger rod connection points with the truss manufacturer.
- F. For suspending hanger rods from brackets attached to walls, use welded steel brackets; Fig. 194 for loads up to 750 lbs; Fig. 195 for loads up to 1500 lbs; Fig 199 for loads up to 3000 lbs.
- G. Where pipes are to be racked along walls, use "Unistrut" pipe racks or 12 gauge steel strut channel, 1-5/8" x 1-5/8" minimum.
1. Mount pipes to strut channel with two-piece pipe straps to match outside diameter of pipe including insulation.

- H. Attach all pipe hangers from support rods using double locknuts tightened to prevent loosening.

### 3.2 INTERMEDIATE ATTACHMENTS

- A. Hanger rods: use carbon steel single or double end threaded, Figs. 140, 253 as required. Continuous threaded rod: Fig. 146 may be used wherever possible.
- B. Chain wire or perforated strap hangers will not be permitted. One pipe shall not be suspended from another pipe.

### 3.3 STRUCTURAL ATTACHMENTS

- A. For attaching steel or copper plated hanger rods to reinforced concrete, use galvanized malleable iron concrete inserts; Fig. 282 for loads up to 1140 lbs.
- B. For attaching steel hanger rods to structural steel beams, use malleable iron C-clamps; Fig. 92, Fig. 93 or Fig. 94 with retaining clip Fig. 89 or Fig. 89X for loads up to 500 lbs; Fig. 218 with extension piece for loads up to 1,365 lbs. For copper plated hanger rods, use copper plated malleable iron C-clamps; Fig. CT-138R for loads up to 180 lbs.
- C. For attaching steel hanger rods to wood structural members, use malleable iron ceiling flange; Fig. 153 for loads up to 1,270 lbs. For copper plated hanger rods, use copper plated malleable iron ceiling flange: Fig. CT-128R for loads up to 180 lbs.
- D. Vertical expansion shields or toggles shall not be used for suspending hanger rods, except with permission in cases where inserts have been omitted or cannot be used. If permitted, use expansion shields; for rod sizes up to ½", 320 lbs. max. load. For hanger rods larger than ½" use attachment plate, Fig. 52, with wedge anchors.
- E. Powder actuated anchoring methods shall not be used.

### 3.4 PIPE COVERING PROTECTION

- A. Hangers and supports for insulated piping shall not injure or pierce insulation. Provide insulation protection shields in conjunction with hanger or roll device. Use Fig. 160 and 165, Protection Saddles.

### 3.5 SUPPLEMENTAL STEEL

- A. Provide supplemental steel required to hang or support mechanical equipment or piping.

**END OF SECTION 23 0529**

SECTION 23 05 48  
VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. This specification pertains to the furnishing and installation of vibration isolation devices for HVAC piping and rotating or reciprocating mechanical equipment.
- B. This work shall include all material and labor required for installation of the resilient mounting and suspension systems, adjusting each mounting system, and measurement of isolator system performance when so requested by the Architect/Engineer. Specific mounting arrangements for each item of mechanical equipment shall be as described herein and as indicated by schedules and details on the drawings.

1.2 QUALIFICATIONS

- A. All rotating mechanical equipment shall be isolated from the structure by means of vibration isolators. The isolators and bases shall be as tabulated on the Vibration Isolation Schedule in this section. Any equipment not listed in this schedule shall be isolated with the isolator type and deflection shown in the 2007 ASHRAE HVAC Applications Handbook, Chapter 47, Table 48.
- B. Vibration isolators and bases shall be as manufactured by Kinetics Noise Control, Mason Industries, Amber Booth or approved equivalent, and shall all be provided by the mechanical contractor form a single manufacturer to assure single responsibility for the performance of all isolation equipment. The isolator manufacturer's submittal shall include a tabulation of the design data with dimensions for both free and operating heights of the isolators.
- C. Engage manufacturer to provide technical supervision of installation of support isolation units produced, and of associated inertia bases.
- D. The Contractor and the vibration isolation manufacturer or his regularly designated and factory authorized representative shall perform the following tasks in addition to the supply and installation of isolation equipment:
  - 1. Obtain from the Architect/Engineer the approved manufacturer's name, model number, and other necessary identifying data for each item of mechanical equipment to be resiliently mounted. Coordinate resilient mounting systems with the exact equipment to be furnished in regard to physical size, isolator locations, weight, rotating speed, etc. Direct contact and cooperation between the vibration isolation device fabricator and the equipment manufacturer will be required.
  - 2. Select piping systems isolators for proper coordination with the physical arrangement of pipe lines and with the physical characteristics of the building.
  - 3. Provide on-the-job supervision as required during installation of resiliently mounted equipment and piping to assure that vibration isolators are installed in strict accordance with normally accepted practices for critical environments.
  - 4. Replace, at no extra cost to the Owner, isolators which do not produce the required deflection, are improperly loaded above or below their correct operating height, or which do not produce the required isolation.
  - 5. Cooperate with other contractors engaged in this project so that the installation of vibration isolation devices will proceed in a manner that is in the best interests of the Owner.

- 6. Notify the Architect/Engineer of project conditions which affect vibration isolation system installation of performance and which are found to be different from conditions indicated by the drawings or described by the specifications. Should vibrations isolation system installation proceed without such notifications, remedial work required to achieve proper isolator performance shall be accomplished by the contractor at no additional cost to the Owner.
- 7. Be alert for possible short-circuiting of vibration isolation systems by piping supports, electrical connections, temperature control connections, drain lines, building construction, etc., and notify the involved contractor as to these problems or potential problems. Where such situations cannot be easily resolved, notify the Architect/Engineer so that preventive or remedial action can take place on a timely basis. Remedial measures required shall be undertaken by the contractor responsible at no additional cost to the Owner.
- E. Vibration isolation products furnished as part of factory-fabricated equipment are specified as part of the equipment assembly in other Division 23 sections.
- F. Refer to other sections of these specifications for equipment foundations, hangers, sealants, gaskets and other work related to vibration isolation work.
- G. Where equipment manufacturer's recommendations differ from specified vibration isolation, submit to Architect for approval.
- H. Furnish templates to fabricators of equipment bases, foundations and other support systems, as needed for coordination of vibration isolation units with other work.

### 1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's specifications, detailed drawings, performance characteristic data and installation instructions for each type of unit required. Indicate equipment to be installed with isolator, tabulation of design data with dimensions for both free and operating heights of isolators, and load on each.

### 1.4 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:
  - 1. Site Class as Defined in the IBC: A.

## PART 2 PRODUCTS

### 2.1 GENERAL

- A. The vibration isolation systems described herein and identified by type number designations shall be applied to specific classifications of mechanical equipment as indicated in the Vibration Isolation Schedule.

### 2.2 TYPE 1 ISOLATORS (RUBBER & GLASS FIBER PADS AND HANGERS)

- A. Pre-compressed Molded Fiberglass Vibration Isolation Pads, individually coated with a flexible moisture impervious elastomeric membrane. Pads shall be fine (.00018 dia.) bonded annealed glass fibers which have been stabilized during manufacture by overloading the material ten times. Pads shall have a constant natural frequency over the operating load range, and the stiffness shall increase proportionately with load applied. Pads shall be no taller than the shortest horizontal dimension. Where the equipment base does not provide a uniform load surface, steel plates shall be bonded to the top of the pads. Alternately, Neoprene Mounts incorporating completely enclosed metal inserts to permit bolting the supported unit may be used.

### 2.3 TYPE 2 ISOLATORS (PAD AND HANGER TYPE)

- A. Molded isolators shall come in a range of 30 to 70 durometer and shall be designed for up to ½" deflection.
- B. Hangers shall be designed for a 20° to 35° misalignment.

### 2.4 TYPE 3 ISOLATORS (SPRINGS)

- A. Freestanding, Unhoused, Laterally Stable Steel Springs with leveling bolts and ¼-in. thick ribbed isolation pads. To assure stability, the spring shall have a lateral spring stiffness equal to the rated vertical stiffness, and shall be designed to provide 50% overload capacity. In capacities up to 5,000 lbs., springs shall be replaceable. In capacities over 5,000 lbs., springs shall be welded to the top and bottom load plate assemblies.
- B. Combination Spring and Rubber Hangers. The pre-compressed fiberglass shall be coated with a moisture impervious elastomeric membrane in series with springs, all encased in welded steel brackets. Springs shall be as specified for Type 3 isolators. Hangers shall be designed for 50% overload capacity, and shall accommodate rod misalignment over a 30° arc. Brackets shall be designed to carry 500% overload without failure.

### 2.5 TYPE 4 ISOLATORS

- A. Freestanding, Laterally Stable Spring Isolators with vertical limit stops to assure a constant operating height if the supported weight is removed, and to reduce movement due to wind loads. Limit stops shall be isolated from the housing to prevent short-circuiting.

### 2.6 TYPE A BASES

- A. No base required. Isolators may be attached directly to the supported equipment.

### 2.7 TYPE B BASES

- A. Structural Steel Base, designed and supplied by reducing the mounting height of equipment. To assure adequate stiffness, the height of the members shall be a minimum of 8% of the longest span between isolators, or at least 6 inches. Where thinner sections are necessary due to head room limitations, the section modulus of the members selected shall be equivalent to or exceed the section modulus of wide flange steel members whose thickness is 8% of the longest span between isolators.

### 2.8 TYPE C BASES

- A. Reinforced Concrete Inertia Base, the steel members of which are designed and supplied by the isolator manufacturer. The concrete shall be poured into a welded steel frame with pre-located equipment anchor bolts, ½-in. diameter reinforcing bars on nominal 8-in. centers each way, and recessed isolator mounting brackets to reduce the mounting height of the equipment, but yet remain within the confines of the base. The thickness of the base shall be a minimum of 8% of the longest span between isolators, at least 6 in., or as indicated on the drawings. Where inertia bases are used to mount pumps, the bases shall be wide enough to support piping elbows.

### 2.9 TYPE D BASES

- A. Roof Curb Isolators: Fabricated frame units sized to match roof curbs as shown, formed with isolation springs between extruded aluminum upper and lower sections, which are shaped and positioned to prevent metal-to-metal contact. Provide continuous airtight and waterproof seal between upper and lower extrusions. Include provisions for anchorage of frame unit to roof curb, and for anchorage of equipment to unit. Equivalent to Mason Type CMAB or RSC as required.

2.10 DUCTWORK ISOLATION

- A. Provide flexible duct connections wherever ductwork connects to vibration isolated equipment. Construct flexible connections of neoprene-coated flameproof fabric crimped into duct flanges for attachment to duct and equipment. Make airtight joint. Provide adequate joint flexibility to allow for thermal, axial, transverse, and torsional movement, and also capable of absorbing vibrations of connected equipment.
- B. Manufacturer: Subject to compliance with requirements, provide flexible connections of one of the following:
  - 1. Elgen Manufacturing Co.
  - 2. Duro Dyne Corporation
  - 3. Ventfabrics, Inc.

2.11 PIPING ISOLATION

- A. Piping over 1 in. diameter in mechanical equipment rooms, and piping three supports away from other mechanical equipment shall be isolated from the structure by means of vibration and noise isolators.
- B. Suspended piping shall be isolated with Type 2 Hangers.
- C. Floor mounted piping shall be isolated with Type 2 Isolators (spring mounts).
- D. Flexible members shall be incorporated in the piping adjacent to all equipment housing pipe connections (cooling tower, unit heaters, air handling units, chillers, etc.).

2.12 ELECTRICAL CONNECTIONS TO RESILIENTLY MOUNTED EQUIPMENT

- A. Electrical connections to equipment which is supported or suspended by vibration isolators shall be made with long lengths of flexible conduit or flexible armored cable. These flexible connections must be located so as to prevent rigid conduit connections between the resiliently mounted equipment and the building structure.

2.13 VIBRATION ISOLATION SCHEDULE

| EQUIPMENT TYPE                                       | ON GRADE    |            | UP TO 20 FT<br>FLR SPAN |                                           | 20 TO 30FT<br>FLR SPAN |            | 20 TO 30FT<br>FLR SPAN |            |
|------------------------------------------------------|-------------|------------|-------------------------|-------------------------------------------|------------------------|------------|------------------------|------------|
|                                                      | TYPE        | MIN<br>DFL | TYPE                    | MIN<br>DFL                                | TYPE                   | MIN<br>DFL | TYPE                   | MIN<br>DFL |
| <b>CONDENSING UNITS</b>                              | B-I         | DFL        | E B-I                   | DFL                                       | E B-I                  | DFL        | E B-I                  | DFL        |
| CONDENSING UNITS                                     | A-1         | 0.25       | A-4                     | 0.75                                      | A-4                    | 1.75       | A/D-4                  | 1.75       |
| <b>PACKAGED ROOFTOP<br/>EQUIPMENT</b>                | TYPE<br>B-I | MIN<br>DFL | TYPE<br>E B-I           | MIN<br>DFL                                | TYPE<br>E B-I          | MIN<br>DFL | TYPE<br>E B-I          | MIN<br>DFL |
| PACKAGED ROOFTOP<br>EQUIPMENT                        | A/D-1       | 0.25       | D-3                     | 0.75                                      |                        |            |                        |            |
| <b>BASE TYPES:</b>                                   |             |            |                         | <b>ISOLATOR TYPES:</b>                    |                        |            |                        |            |
| A. NO BASE, ISOLATORS ATTACHED DIRECTLY TO EQUIPMENT |             |            |                         | 1. PAD, RUBBER, OR GLASS FIBER            |                        |            |                        |            |
| B. +PAD, RUBBER, OR GLASS FIBER                      |             |            |                         | 2. RUBBER FLOOR ISOLATOR OR HANGER        |                        |            |                        |            |
| C. CONCRETE INERTIA BASE                             |             |            |                         | 3. SPRING FLOOR ISOLATOR OR HANGER        |                        |            |                        |            |
| D. CURB-MOUNTED BASE                                 |             |            |                         | 4. RESTRAINED SPRING ISOLATOR             |                        |            |                        |            |
|                                                      |             |            |                         | 5. THRUST RESTRAINT (SEE ASHRAE HANDBOOK) |                        |            |                        |            |

## **PART 3 INSTALLATION**

### **3.1 EXECUTION**

- A. General: Except as otherwise indicated, comply with manufacturer's instructions for the installation and load application to vibration isolation materials and units. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading, and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices (if any) intended for temporary protection against overloading during installation.
- B. Anchor and attach units to substrate and equipment as required for secure operation and to prevent displacement by normal forces, and as indicated.
- C. Adjust leveling devices as required to distribute loading uniformly onto isolators. Shim units as required where leveling devices cannot be used to distribute loading properly.
- D. Flexible Pipe Connectors: Refer to other section of these Specifications for the installation of flexible pipe connectors.
- E. Install vibration isolators that are furnished with equipment.

**END OF SECTION 23 0548**

SECTION 23 05 53  
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Provide materials, equipment labor and supervision necessary to install piping identification products.
- B. Comply with ANSI A13.1 for lettering size, length or color field, colors, and installed viewing angles of identification devices.

1.2 QUALIFICATIONS

- A. Brady Corp., Industrial Safety Supply, Emedco, Seton or Brimar.

1.3 SUBMITTALS

- A. Submit manufacturer's product data.

**PART 2 PRODUCTS**

2.1 EQUIPMENT MARKERS

- A. Provide engraved signage nameplates and tags constructed of multi-layered acrylic that has been treated for outdoor use and can withstand temperatures up to 160° F. Nameplates shall have beveled edges with contrasting color core, letters, and border. Minimum size of nameplate shall be 3" high by 6" long. The minimum letter height shall be 3/4". Attachment shall be by double faced 2 mil permanent acrylic adhesive. For equipment that doesn't allow for direct attachment, furnish sheet metal backing to integrate with equipment such that signage can be read from 5 feet above the finished floor. Unless noted otherwise, signage shall be provided with black lettering, black border, and yellow core. All signage shall include up to 14 characters per line, minimum of 3 lines per tag. Furnish signage for equipment shown in Section 3:
  - 1. All pumps shall include the full name description for system served such as *"Primary Chilled Water Pump – 1."*
  - 2. All air handling unit filter sections shall be labeled with the exact quantity of filters, size, and type of filter such as *"14 – 24"x24"x2", 30% Pleated Filters."*
- B. All equipment shall be named consistent with the plans and specifications as indicated on the schedules or as directed by the Owner.

**PART 3 EXECUTION**

3.1 INSTALLATION OF MECHANICAL IDENTIFICATION

- A. Where identification is to be applied to surfaces that require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.



### 3.2 ADJUSTING AND CLEANING

- A. Relocate any mechanical identification device which has become visually blocked by work of this division or other divisions.
- B. Clean face of identification devices and glass frames of valve schedules.

### 3.3 EQUIPMENT IDENTIFICATION

- A. Equipment/Ductwork
  - 1. Mini Split Units
  - 2. Rooftop Units
  - 3. Unit Heaters
  - 4. Directional arrows indicating flow of air at discharge and inlet of air handling units.
  - 5. Provide name plates for all equipment scheduled on the drawings. Coordinate nameplate tag with Owner's sequencing system. If the Owner has no preference, the nameplates shall correspond with the equipment schedule.

**END OF SECTION 23 0553**

SECTION 23 05 93  
TESTING, ADJUSTING, AND BALANCING FOR HVAC

**PART 1 GENERAL**

1.1 SUMMARY

- A. Testing, adjustment, and balancing of air systems.
- B. Measurement of final operating condition of HVAC systems.

1.2 QUALIFICATIONS

- A. Testing and balancing shall be performed by an independent certified testing and balancing contractor. The Contractor shall be certified by the AABC (American Association of Balancing Contractors), NEBB (National Environmental Balancing Bureau), or SMARTA (Sheet Metal and Air Conditioning and Roofing Trade Association). The Balancing Contractor shall provide labor, services, and test equipment required to test, adjust, and balance the specified systems. Personnel involved in the execution of the work under the Balancing Contract shall be experienced and trained in the total balancing of mechanical systems, as well as being regular employees of the Balancing Contractor.

1.3 SUBMITTALS

- A. Submit under provisions of Division 01.
- B. Submit name of adjusting and balancing agency for approval within 30 days after award of Contract.
- C. Field Reports: Submit under provisions of Division 01.
- D. Field Reports: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
- E. Prior to commencing work, submit report forms or outline indicating adjusting, balancing, and equipment data required.
- F. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect/Engineer and for inclusion in operating and maintenance manuals.
- G. Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
- H. Include detailed procedures, agenda, sample report forms and copy of AABC National Project Performance Guaranty prior to commencing system balance.
- I. Test Reports: Indicate data on forms containing information indicated in Schedules.
- J. Submit data in S.I. Metric units.

1.4 SEQUENCING

- A. Sequence work to commence after completion of systems installation and schedule completion of balancing work before Substantial Completion of Project.
- B. Do not proceed with balancing work until systems scheduled for testing, adjusting, and balancing are clean and free from debris, dirt, and discarded building materials.

## **PART 2 PRODUCTS (NOT USED)**

## **PART 3 EXECUTION**

### **3.1 OTHER CONTRACTOR RESPONSIBILITIES**

- A. The Mechanical and Plumbing Contractors shall cooperate with the balancing agency by:
  - 1. Including balancing dampers as required by the Drawings and Specifications.
  - 2. Putting complete system into operation during duration of balancing period.
  - 3. Providing up-to-date set of Drawings and advising immediately of changes made to the system during construction.
  - 4. Providing labor and equipment and cost of performing corrections such as dampers, belts, and pulley changes, etc. as required without undue delay.
  - 5. Providing complete submittal information for mechanical equipment complete with pertinent engineering information.

### **3.2 EXAMINATION**

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions.
  - 1. Systems are started and operating in a safe and normal condition.
  - 2. Temperature control systems are installed complete and operable.
  - 3. Proper thermal overload protection is in place for electrical equipment.
  - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
  - 5. Duct systems are clean of debris.
  - 6. Fans are rotating correctly.
  - 7. Fire and volume dampers are in place and open.
  - 8. Air coil fins are cleaned and combed.
  - 9. Access doors are closed and duct end caps are in place.
  - 10. Air outlets are installed and connected.
  - 11. Duct system leakage is minimized.
- B. Submit field reports. Report defects and deficiencies noted during performance of services which prevent system balance.
- C. Beginning of work means acceptance of existing conditions.

### **3.3 PREPARATION**

- A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect/Engineer to facilitate spot checks during testing.
- B. Provide additional balancing devices as required.

### 3.4 INSTALLATION TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 of design for return and exhaust systems.
- B. Diffusers, Registers and Grilles: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust diffusers, registers and grilles in space to within plus or minus 10 percent of design.

### 3.5 ADJUSTING

- A. Ensure recorded data represents actual measured or observed conditions.
- B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostat to specified settings.
- E. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.
- F. Check and adjust systems approximately six months after final acceptance and submit report.

### 3.6 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.
- B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- E. Use volume control devices to regulate air quantities only to the extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowance for 50 percent loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

### 3.7 SCHEDULES

#### A. Equipment Requiring Testing, Adjusting, and Balancing

1. Packaged Roof Top Heating/Cooling Units
2. Diffusers, Registers and Grilles

#### B. OUTDOOR AIR VENTILATION DATA

1. Air Handling Units shall be tested and balanced for the following conditions:
  - a. Leakage when the outdoor air damper is in the closed position and the unit is operating at 100% scheduled speed. Adjust damper if required to reduce leakage to the maximum allowable leakage rate as specified.
  - b. Capacity as scheduled on the drawings
2. Coordinate testing with the temperature controls contractor and identify the % actuator stroke correlating with the above capacities.
3. Submit this in report form to the engineer prior to submitting final report.

#### C. REPORT FORMS

1. Title Page:
  - a. Name of Testing, Adjusting, and Balancing Agency
  - b. Address of Testing, Adjusting, and Balancing Agency
  - c. Telephone number of Testing, Adjusting, and Balancing Agency
  - d. Project name
  - e. Project location
  - f. Project Architect
  - g. Project Engineer
  - h. Project Contractor
  - i. Project altitude
  - j. Report date
2. Summary Comments:
  - a. Design versus final performance
  - b. Notable characteristics of system
  - c. Description of systems operation sequence
  - d. Summary of outdoor and exhaust flows to indicate amount of building pressurization
  - e. Nomenclature used throughout report
  - f. Test conditions

3. Instrument List:
  - a. Instrument
  - b. Manufacturer
  - c. Model number
  - d. Serial number
  - e. Range
  - f. Calibration date
4. Electric Motors:
  - a. Manufacturer
  - b. Model/Frame
  - c. HP/BHP.
  - d. Phase, voltage, amperage; nameplate, actual, no load
  - e. RPM
  - f. Service factor
  - g. Starter size, rating, heater elements
  - h. Sheave Make/Size/Bore
5. V-Belt Drive:
  - a. Identification/location
  - b. Required driven RPM
  - c. Driven sheave, diameter and RPM
  - d. Belt, size and quantity
  - e. Motor sheave diameter and RPM
  - f. Center to center distance, maximum, minimum, and actual
6. Air Moving Equipment
  - a. Location
  - b. Manufacturer
  - c. Model number
  - d. Serial number
  - e. Arrangement/Class/Discharge
  - f. Supply air flow, specified and actual
  - g. Return air flow, specified and actual
  - h. Relief air flow, specified and actual
  - i. Outside air flow, specified and actual
  - j. Total static pressure (total external), specified and actual

- k. Inlet pressure
  - l. Discharge pressure
  - m. Sheave Make/Size/Bore
  - n. Number of Belts/Make/Size
  - o. Fan RPM
  - p. Fan BHP
7. Return Air/Outside Air Data:
- a. Identification/location
  - b. Design air flow
  - c. Actual air flow
  - d. Design return air flow
  - e. Actual return air flow
  - f. Design outside air flow
  - g. Actual outside air flow
  - h. Return air temperature
  - i. Outside air temperature
  - j. Required mixed air temperature
  - k. Actual mixed air temperature
  - l. Design outside/return air ratio
  - m. Actual outside/return air ratio
8. Air Distribution Test Sheet (Diffusers, Registers and Grilles):
- a. Air terminal number
  - b. Room number/location
  - c. Terminal type
  - d. Terminal size
  - e. Area factor
  - f. Design velocity
  - g. Design air flow
  - h. Test (final) velocity
  - i. Test (final) air flow
  - j. Percent of design air flow

**END OF SECTION 23 0593**

SECTION 23 07 00  
HVAC INSULATION

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Provide equipment, materials, labor and supervision necessary to install insulation to hot and cold surfaces of piping, tanks, ductwork, fittings and other surfaces.
- B. Insulation shall include insulating materials, jackets, adhesive, mastic coatings, tie wire and other materials as required to complete the insulating work.

1.2 CODES AND STANDARDS

- A. Insulating materials, jackets and mastics shall meet flame spread, fuel contribution and smoke developed ratings in accordance with NFPA-90A. Flame spread rating in accordance with NFPA 255, ASTM E-84 or UL 723 of not more than 25; smoke developed rating of not more than 50, unless otherwise noted in this section.
- B. Insulation that has been treated with a flame-retardant additive to meet the flame spread and smoke developed ratings shown above is not permitted.
- C. Insulation materials shall be noncorrosive to the materials they are applied to, including stress corrosion cracking of stainless steel, and shall not breed or promote fungus and bacteria.
- D. Insulation shall meet or exceed all requirements of the 2012 International Energy Conservation Code.

1.3 QUALIFICATION

- A. Insulating materials by Owens-Corning, Aracell, Pittsburgh-Corning, Knauf, Johns Manville, or approved equivalent.
- B. Mastics and adhesives as recommended by insulation manufacturer.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, flame spread and smoke development rating, k-value, density, temperature limitations, sound absorption coefficients, thickness, and furnished accessories for each mechanical system requiring insulation.

**PART 2 PRODUCTS**

2.1 PRODUCTS

- A. Description:
  - 1. Type B: Flexible, elastomeric pipe and sheet insulation with closed-cell structure. Shall comply with ASTM C534, Type I, Grade 1 for tubular materials and ASTM C534 Type II, Grade 1 for sheet materials. Suitable for operating temperatures from -40° F to 220° F. Outdoor applications, and where otherwise noted, shall receive a weather-resistant, protective, latex enamel finish. Thermal conductivity of 0.28 BTU-in/hr-ft<sup>2</sup>-°F @ 75° F mean temperature. Water vapor permeance of 0.08 perms. Insulation shall be equivalent to Armacell AP Armaflex; adhesive equivalent to Armacell Armaflex 520 or Armaflex 520 BLV Low-VOC Contact Adhesive; finish equivalent to Armacell Armaflex WB finish.



2. Type H: Rigid fiberglass board formed from inorganic glass fibers bonded with thermosetting fibers, 3.0 PCF, with factory applied foil Skrim-Kraft (FSK) foil Skrim-Kraft (FSK) suitable for operating temperature of  $-20^{\circ}$  F to  $+450^{\circ}$  F. Thermal conductivity of 0.23 BTU-in/hr-ft<sup>2</sup>- $^{\circ}$ F @ 75 $^{\circ}$  F mean temperature. Water vapor permeance of 0.02 perms. Knauf "Insulation Board" or approved equivalent.
3. Type I: Fiberglass duct wrap, 1.5 PCF density, fabricated of inorganic glass fibers bonded with thermosetting resin with factory applied foil Skrim-Kraft facing, suitable for operating temperature up to  $+250^{\circ}$  F. Thermal conductivity of 0.26 BTU-in/hr-ft<sup>2</sup>- F @ 75 F mean temperature. Water vapor permeance of 0.02 perms. Knauf Duct Wrap or engineer approved equivalent.
4. Type J: Flexible fiberglass duct liner, 1.5 PCF density, fabricated of inorganic glass fibers bonded with thermosetting resin, with mat face suitable for air velocities up to 4000 FPM and operating temperatures up to  $+250^{\circ}$  F. Thermal conductivity of 0.25 BTU-in/hr-ft<sup>2</sup>- $^{\circ}$ F @ 75 $^{\circ}$  F mean temperature. Knauf "Duct Liner E-M" or engineer approved equivalent.

### **PART 3 EXECUTION**

#### **3.1 INSTALLATION, GENERAL**

- A. Use only experienced applicators regularly engaged in the trade. Rough work will be rejected. Application details shall be in accordance with the insulation materials supplier's recommendations, except where a higher standard is specified.
- B. Install materials after systems have been tested and approved. Material such as rust, scale, dirt and moisture shall be removed from surfaces to be insulated.
- C. Insulation shall be kept clean and dry at all times.
- D. Where pipes and ducts pass through fire rated walls, floors and partitions, a fire seal shall be provided.

#### **3.2 DUCT COVERING APPLICATION**

- A. Covering shall be cut slightly longer than circumference of duct to ensure full thickness at corners. Insulation shall be applied with edges tightly banded, and shall be adhered to duct with fire-resistant adhesive. Adhesive shall be applied so that insulation conforms to duct surfaces uniformly and firmly.
- B. In addition to the adhesive, the insulation shall be additionally secured to the bottom of ducts 18" or wider by means of adhesive pins and speed clips. The protruding ends of the pins shall be cut off flush after the speed clips have been applied. The vapor barrier facing shall be thoroughly sealed with a vapor barrier mastic and tape where the pins have pierced through. The vapor barrier shall be continuous to prevent condensation. Insulation shall not be compressed at any location so as to reduce insulating characteristics.
- C. Joints shall be sealed with 2" wide pressure-sensitive tape or vapor barrier tape or strips, using a fire-resistive adhesive. Cuts or tears shall be sealed with strips of vapor barrier jacket applied with adhesive or pressure-sensitive tape.

3.3 PIPE INSULATION SCHEDULE (BASED ON 2012 IECC)

| SERVICE                                     | TEMP ( F) | TYPE | NOMINAL PIPE SIZE (INCHES) |                       |                       |               |      |
|---------------------------------------------|-----------|------|----------------------------|-----------------------|-----------------------|---------------|------|
|                                             |           |      | <1                         | 1<br>TO<br><1-<br>1/2 | 1-<br>1/2<br>TO<br><4 | 4<br>TO<br><8 | 8+   |
| Refrigerant Suction,<br>Refrigerant Hot Gas |           | B    | 1/2"                       | 3/4"                  | 3/4"                  | 3/4"          | 3/4" |

3.4 MINIMUM DUCT INSULATION SCHEDULE (BASED ON 2012 IECC)

| SERVICE                                                                                              | TYPE | THICKNESS |
|------------------------------------------------------------------------------------------------------|------|-----------|
| Outdoor Air Ducts                                                                                    | I    | 2"        |
| Supply Air Ducts                                                                                     | I    | 2"        |
| Return Air Ducts                                                                                     | I    | 2"        |
| Diffusers (top/backside)                                                                             | I    | 2"        |
| Transfer Ducts                                                                                       | J    | 1/2"      |
| Return Ducts Within 20'-0" of Return Fan                                                             | J    | 1"        |
| Exhaust Ducts Exposed to Outside Air, in Equipment rooms and for 10'-0" Beyond Mechanical Room Walls | I    | 1-1/2"    |

**END OF SECTION 23 0700**

SECTION 23 09 00  
INSTRUMENTATION AND CONTROL FOR HVAC

**PART 1 GENERAL**

1.1 SUMMARY

- A. Provide materials, labor, and supervision necessary to furnish and install a Direct Digital Control (DDC) system. The DDC system herein specified shall be fully integrated and installed as a complete package by the Direct Digital Control Manufacturer. The system shall include all computer software and hardware, operator input/output devices, automation sensors and controls, wiring, piping, installation, supervision and labor, calibration, adjustments and check out necessary for a complete and fully operational system.

1.2 QUALIFICATIONS

- A. The control system shall meet specifications and qualifications as described. The controls contractor shall have a minimum of five years experience associated with variable air volume systems and constant volume systems and other systems as required by the sequence of operations.
- B. The DDC controls system shall be an extension of the existing Distech system.
- C. All work is to be installed by a qualified person skilled in the installation of electronic automatic control systems. The control contractor is responsible for the proper installation of the control system.
  - 1. The Installer shall have an established working relationship with the Control System Manufacturer of not less than three years.
  - 2. The installer shall have a service office within 50 miles of the project site and provide 24-hour response in the event of a customer call.
- D. The contractor may elect to subcontract the installation of the electronic control system but will be responsible in total as outlined above.
- E. All products used in this installation shall be new, currently under manufacture, and shall be applied in similar installations for a minimum of 2 years. This installation shall not be used as a test site for any new products unless explicitly approved by the Owner's representative in writing prior to bid date. Spare parts shall be available for at least 10 years after completion of this contract. List below only products, construction, and equipment that the reader might expect to find in this Section but are specified elsewhere.

1.3 WORK BY OTHERS

- A. The following incidental work shall be furnished by the Mechanical Contractor under the supervision of this Contractor.
  - 1. Furnish and install all necessary valves, pressure taps, flow meters, water, drain and overflow connections and piping.
  - 2. Furnish and install all necessary piping connections required for flow devices, valve position indicators, etc.
  - 3. Install all automatic dampers and minimum outdoor air stations, airflow stations.
  - 4. Provide necessary blank off plates (safing) required to install dampers that are smaller than duct size.
  - 5. Provide access door or other approved means of access through ducts for service to control equipment.

#### 1.4 DESCRIPTION

- A. Direct Digital Control (DDC) technology shall be used to provide the functions necessary for control of mechanical systems on this project.
- B. The control system shall accommodate simultaneous multiple user operation. Access to the control system data should be limited only by operator password. Multiple users shall have access to all valid system data. An operator shall be able to log onto any workstation on the control system and have access to all appropriate data.
- C. The control system shall be designed such that each mechanical system will be able to operate under stand-alone control. As such, in the event of a network communication failure, or the loss of any other controller, the control system shall continue to independently operate under control.
- D. Communication between the control panels and all workstations shall be over a high-speed network. All nodes on this network shall be peers. The operator shall not have to know the panel identifier or location to view or control an object. Application Specific Controllers shall be constantly scanned by the network controllers to update point information and alarm information.
- E. The documentation is schematic in nature. The Contractor shall provide hardware and software necessary to implement the functions and sequences shown.

#### 1.5 SUBMITTALS

- A. Qualification of Guaranteed Unit Pricing
  - 1. A list of pricing criteria for components that include remote control units, foundation modules, input/output modules, expansion modules, standalone controller, modems, damper actuators, valves, valve actuators, sensors, transmitters, controllers, relays, EP switches, PE switches, accessories, thermostats, standard software, special software, and any other items necessary for future expansion of the system.
  - 2. Include an hourly rate labor cost for 24-hour on call service technicians.
  - 3. It is desired to obtain a guarantee on the pricing criteria (including any multiplier) for a period of five (5) years not to exceed cost of living index. The submittal must indicate the guaranteed prices and be signed by an officer of the control company.
  - 4. The pricing criteria list shall be submitted to the Owner for review and approval upon request.
  - 5. A submittal of the owner training program will be required for review and approval by the Owner.
  - 6. An Owner approved guaranteed unit pricing submittal is required upon request.
  - 7. Preliminary wiring/communications hierarchy indicating communication levels between devices containing microprocessors.
- B. Contractor shall provide shop drawings and manufacturers' standard specification data sheets on all hardware and software to be provided. No work may begin on any segment of this project until submittals have been reviewed by the Engineer and Owner for conformity with the plan and specifications. All shop drawings shall be done on AutoCAD, and provided to the Engineer for review and to the Owner on electronic media.
- C. Quantities of items submitted shall be reviewed by the Engineer and Owner. Such review shall not relieve the contractor from furnishing quantities required for completion.
- D. Provide the Engineer and Owner, any additional information or data which is deemed necessary to determine compliance with these specifications or which is deemed valuable in documenting the system to be installed.

- E. Submit the following within 30 days of contract award:
1. A complete bill of materials of equipment to be used indicating quantity, manufacturer and model number.
  2. A schedule of all control valves including the valve size, model number (including pattern and connections), flow, CV, pressure rating, and location.
  3. Provide manufacturers cut sheets for major system components. When manufacturer's cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawings shall clearly reference the specification and/or drawing that the submittal is being submitted to cover. Include:
    - a. Building Controllers, Custom Application Controllers, and Application Specific Controllers
    - b. Operator Interface Computer
    - c. Auxiliary Control Devices
    - d. Proposed control system riser diagram showing system configuration, device locations, addresses, and cabling.
    - e. Detailed termination drawings showing all required field and factory terminations. Terminal numbers shall be clearly labeled.
    - f. Points list showing all system objects, and the proposed English language object names.
    - g. Sequence of operations for each system under control. This sequence shall be specific for the use of the Control System being provided for this project.
    - h. Color prints of proposed graphics with a list of points for display.
- F. Project Record Documents: Upon completion of installation submit five (5) copies of record (as-built) documents. The documents shall be submitted for approval prior to final completion and include:
1. Project Record Drawings - These shall be as-built versions of the submittal shop drawings. One set of magnetic media including CAD .DWG or .DXF drawing files shall also be provided.
  2. Operating and Maintenance (O & M) Manual - These shall be as-built versions of the submittal product data. In addition to that required for the submittals, the O & M manual shall include:
    - a. Names, address and 24-hour telephone numbers of Contractors installing equipment, and the control systems and service representative of each.
    - b. Operators Manual with procedures of operating the control systems including logging on/off, alarm handling, producing point reports, trending data, overriding computer control, and changing set points and other variables.
    - c. Programming Manual with a description of the programming language including syntax, statement descriptions including algorithms and calculations used, point database creation and modification, program creation and modification, and use of the editor.

- d. Engineering, Installation and Maintenance Manual(s) that explains how to design and install new points, panels, and other hardware; preventative maintenance and calibration procedures; how to debug hardware problems; and how to repair or replace hardware.
  - e. A listing and documentation of all custom software created using the programming language including the point database. One set of magnetic media containing files of the software and database shall also be provided
  - f. One set of magnetic media containing files of all color-graphic screens created for the project.
  - g. A list of recommended spare parts with part numbers and supplier.
  - h. Complete original issue documentation, installation and maintenance information for all third-party hardware provided including computer equipment and sensors.
  - i. Complete original issue diskettes for all software provided including operating systems, programming language, operator workstation software, and graphics software.
  - j. Licenses, Guarantee, and Warrantee documents for all equipment and systems.
  - k. Recommended preventive maintenance procedures for all system components including a schedule of tasks (inspection, cleaning, calibration, etc.), time between tasks, and task descriptions.
- G. Training Manuals: The Contractor shall provide a course outline and training manuals for all training classes at least six weeks prior to the first class. The Owner reserves the right to modify any or all of the training course outline and training materials. Review and approval by Owner and Engineer and shall be completed at least 3 weeks prior to first class.

## 1.6 CODES & STANDARDS

- A. Input/output devices, specified or future, associated with the DDC control system shall be ASCII (American Standard Code for Information Interchange) coded with standard EIA (Electronic Industries Association) interface hardware.
- B. Wiring performed by the DDC Contractor shall be installed in accordance with all applicable local, state, and national codes.
- C. Instrumentation hardware shall be supplied to directly interface with Instrument Society of America (ISA) Standards.
- D. Meet requirements of all applicable standards and codes, except when more detailed or stringent requirements are indicated by the Contract Documents, including requirements of this Section.
  - 1. Underwriters Laboratories: Products shall be UL-916-PAZX listed.
  - 2. National Electrical Code - NFPA 70.
  - 3. Federal Communications Commission - Part J.

## 1.7 WARRANTY

- A. Labor & materials for control system specified shall be warranted free from defects for a period of twelve (12) months after final completion acceptance by the Owner. Control System failures during the warranty period shall be adjusted, repaired, or replaced at no charge or reduction in service to the Owner. The Contractor shall respond to the Owner's request for warranty service within 24 hours during customary business hours.

- B. Operator workstation software, project specific software, graphics, database, and firmware updates shall be provided to the Owner at no charge during the warranty period. Written authorization by Owner must, however, be granted prior to the installation of such changes.

1.8 OWNERSHIP OF PROPRIETARY MATERIAL

- A. All project developed hardware and software shall become the property of the Owner. These include but are not limited to: Project graphic images, Record drawings, Project database, Job-specific application programming code, All documentation.

1.9 SYSTEM PERFORMANCE

- A. Performance Standards. The system shall conform to the following:
  1. Graphic Display. The system shall display a graphic with a minimum of 20 dynamic points.
  2. Graphic Refresh. The system shall update all dynamic points with current data within 30 seconds.
  3. Object Command. The maximum time between the command of a binary object by the operator and the reaction by the device shall be 30 seconds. Analog objects shall start to adjust within 30 seconds.
  4. Object Scan. All changes of state and change of analog values shall be transmitted over the high-speed network such that any data used or displayed at a controller or workstation will be current, within the prior 60 seconds.
  5. Alarm Response Time. The maximum time from when an object goes into alarm to when it is annunciated at the workstation shall not exceed 45 seconds.
  6. Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 5 seconds. The Contractor shall be responsible for selecting execution times consistent with the mechanical process under control.
  7. Performance. Programmable Controllers shall be able to execute DDC PID control loops at a selectable frequency from at least once every 5 seconds. The controller shall scan and update the process value and output generated by this calculation at this same frequency.
  8. Multiple Alarm Annunciation. All workstations on the network shall receive alarms within 5 seconds of each other.
  9. Reporting Accuracy. Table 1 lists minimum acceptable reporting accuracies for all values reported by the specified system.

a. TABLE I -- REPORTING ACCURACY

| <u>Measured Variable</u>      | <u>Reported Accuracy U.N.O</u> |
|-------------------------------|--------------------------------|
| Space temperature             | ±1°F                           |
| Ducted air                    | ±2°F                           |
| Outside air                   | ±2°F                           |
| Delta-T                       | ±0.25°F                        |
| Relative humidity             | ±5% RH                         |
| Air flow (terminal)           | ±10% of reading *Note 1        |
| Air flow (measuring stations) | ±5% of reading                 |
| Air pressure (ducts)          | ±0.1" W.G.                     |
| Electrical power              | 5% of reading                  |
| Note 1: 10%-100% of scale     |                                |

## **PART 2 PRODUCTS**

### **2.1 OPERATOR INTERFACE (EXISTING PC)**

- A. Furnish a full graphics system to interface with the owners existing PC "operator workstation". The system shall include all software and hardware necessary to provide full graphics at the location of the existing operator workstation. Verify the available PC system data and furnish additional hardware to meet the requirements of this section.
- B. All alarms shall print out on the owners existing printer.

### **2.2 SUPERVISED TRAINING**

- A. Provide five (5) working days (40 hours) of supervised training for the Owners representatives to include system operation, programming, report generation, and construction of graphics. Training shall take place at the project site during the normal work hours of 8am to 5pm weekdays. Training shall include:
  - 1. Explanation of drawings, operations and maintenance manuals.
  - 2. Walk-through of the job to locate control components.
  - 3. Operator workstation and peripherals.
  - 4. DDC custom application controllers, ASC, TEC, SAC operation and function.
  - 5. Operator control functions including graphic generation and field panel programming.
  - 6. Explanation of adjustment, calibration and replacement procedures.
- B. Provide operator orientation to the overall operational program, equipment functions (both individually and as part of the total integrated system), commands, advisories, and appropriate operator intervention required in responding to the systems operation. An Owner's manual prepared for this project by the DDC manufacturer shall be used in addition to the instruction. Five copies of the Owner's manual shall be provided.
- C. The technical training will also include adequate instruction and documentation to enable maintenance staff to trouble shoot, repair, and maintain entire system and recreate all programming without factory assistance.
- D. The technical training will also include adequate instruction and documentation to allow expansion by the maintenance staff of the system in the future to interface with existing pneumatic, electric, and electronic control systems. This would include activities associated with hardware and software.

### **2.3 COMMISSIONING OF SYSTEM**

- A. The Temperature Control Contractor shall verify that each analog and binary device and operator responds correctly to the signal given at the control panel by physically changing each parameter and witnessing the correct corresponding reaction. The results of this testing shall be logged in a written report and submitted to the Owner and Engineer prior to final payment.
- B. The Owner's representative shall witness the commissioning of the system.

### **2.4 SYSTEM SOFTWARE**

- A. Operating System. Furnish a commercially available, concurrent multi-tasking operating system. The operating system shall also support the use of other common software applications that operate under Microsoft Windows. Examples include Lotus 123, Microsoft Excel, Word Perfect, and Paradox. Acceptable operating systems are Windows NT, Windows 95 (or later version), Unix, and OS/2.



- B. System Graphics. The Operator Workstation software shall be graphically oriented. The system shall allow display of up to 10 graphic screens at once for comparison and monitoring of system status. Provide a method for the operator to easily move between graphic displays and change the size and location of graphic displays on the screen. The system graphics shall be able to be modified while on line. An operator with the proper password level shall be able to add, delete, or change dynamic points on a graphic. Dynamic points shall include analog and binary values, dynamic text, static text, and animation files. Graphics shall have the ability to show animation by shifting image files based on the status of the point.
1. Custom Graphics. Custom graphic files shall be created with the use of a graphics generation package furnished with the system. The graphics generation package shall be a graphically based system that uses the mouse to create and modify graphics that are saved in industry standard formats such as PCX, TIFF, and GEM. The graphics generation package shall also provide the capability of capturing or converting graphics from other programs such as Designer, or AutoCAD.
  2. Graphics Library. Furnish a complete library of standard HVAC equipment such as chillers, boilers, air handlers, terminals, unit heaters, fan coils, and unit ventilators. This library shall also include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. The library shall be furnished in a file format compatible with the graphics generation package program. All individual pieces of equipment shall be graphically represented with input and output values (both binary and analog).
  3. Engineering Units. Allow for selection of the desired engineering units in the system. Unit selection shall be able to be customized by locality to select the desired units for each measurement. Engineering units on this project shall be Standard Inch Pound.

## 2.5 SYSTEM APPLICATIONS

- A. Each workstation shall provide operator interface and off-line storage of system information. Provide the following applications at each workstation.
1. Automatic System Database Save and Restore. Each workstation shall store on the hard disk a copy of the current database of each building controller. This database shall be updated whenever a change is made in any panel in the system. The storage of this data shall be automatic and not require operator intervention. In the event of a database loss in a building management panel, the first workstation to detect the loss shall automatically restore the database for that panel.
  2. Manual Database Save and Restore. A system operator with the proper password clearance shall be able to archive the database from any system panel and store on magnetic media. The operator shall also be able to clear a panel database and manually initiate a download of a specified database to any panel in the system.
  3. System Configuration. The workstation software shall provide a graphical method of configuring the system. The user with proper security shall be able to add new devices, assign modems to devices, and obtain a visual riser diagram of the system. This shall allow for future system changes or additions.
  4. On-Line Help. Provide a context sensitive, on line help system to assist the operator in operation and editing of the system. On line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext.

5. Security. Each operator shall be required to log on to the system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system supervisor shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operator's access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto logoff time shall be set per operator password. All system security data shall be stored in an encrypted format.
6. Alarm Processing. Any object in the system shall be configurable to alarm in and out of normal state. The operator shall be able to configure the alarm limits, warning limits, states, and reactions for each object in the system.
  - a. Alarm Reactions. The operator shall be able to determine what actions, if any, are to be taken, by object (or point), during an alarm. Actions shall include logging, printing, starting programs, displaying messages, dialing out to remote stations, paging, providing audible annunciation or displaying specific system graphics. Each of these actions shall be configurable by workstation and time of day. An object in alarm that has not been acknowledged within an operator specified time period shall be re-routed to an alternate operator specified alarm receipt device.
  - b. Binary Alarms. Each binary object shall be set to alarm based on the operator specified state. Provide the capability to disable alarming when the associated equipment is turned off or is being serviced.
  - c. Analog Alarms. Each analog object shall have both high and low alarm limits and warning limits. Alarming must be able to be automatically and manually disabled.
7. Trend Logs. The operator shall be able to define a custom trend log for any data in the system. This definition shall include interval, start-time, and stop-time. Trend intervals of 1, 5, 15, 30, and 60 minutes as well as once a shift (8 hours), once a day, once a week, and once a month shall be selectable. All trends shall start based on the hour. Each trend shall accommodate up to 64 system objects. The system operator with proper password shall be able to determine how many samples are stored in each trend. Trend data shall be sampled and stored on the Building Controller panel and be archived on the hard disk. Trend data shall be able to be viewed and printed from the operator interface software. They shall also be storable in a tab delimited ASCII format for use by other industry standard word processing and spreadsheet packages.
8. Alarm and Event Log. The operator shall be able to view all logged system alarms and events from any location in the system. Events shall be listed chronologically. An operator with the proper security level may acknowledge and clear alarms. All that have not been cleared by the operator shall be archived to the hard disk on the workstation.
9. Object and Property Status and Control. Provide a method for the operator with proper password protection to view, and edit if applicable, the status of any object and property in the system. These statuses shall be available by menu, on graphics, or through custom programs.
10. Clock Synchronization. The real time clocks in all building control panels and workstations shall be synchronized on command of an operator. The system shall also be able to automatically synchronize all system clocks, daily from any operator designated device in the system. The system shall automatically adjust for daylight savings and standard time if applicable.

11. Reports and Logs. Provide a reporting package that allows the operator to select, modify, or create reports. Each report shall be definable as to data content, format, interval, and date. Report data shall be archived on the hard disk for historical reporting. Provide the ability for the operator to obtain real time logs of designated lists of objects. Reports and logs shall be stored on the PC hard disk in a format that is readily accessible by other standard software applications including spreadsheets and word processing. Reports and logs shall be readily printed to the system printer.
  - a. Custom Reports: Provide the capability for the operator to easily define any system data into a daily, weekly, monthly, or annual report. These reports shall be time and date stamped and shall contain a report title and the name of the facility.
  - b. Standard Reports. The following standard system reports shall be provided for this project. These reports shall be readily customized to the project by the owner.
    - 1) Electrical Meter Report: Provide a monthly report showing the daily electrical consumption and peak electrical demand for each building meter. Provide an annual (12 month) summary report showing the monthly electrical consumption and peak demand for each meter.
    - 2) Gas Meter Report: Provide a monthly report showing the daily natural gas consumption for each meter. Provide an annual (12 month) report that shows the monthly consumption for each meter.
    - 3) Weather Data Report: Provide a monthly report showing the daily minimum, maximum and average outdoor air temperature and the number of heating and cooling degree days for each day. Provide an annual (12 month) report showing the minimum, maximum and average outdoor air temperature for the month and the number of heating and cooling degree days for the month.
    - 4) Tenant Override Reports: Provide a monthly report showing the daily total time in hours that each tenant has requested after hours HVAC and lighting services. Provide an annual summary report that shows the override usage on a monthly basis.
- B. Workstation Applications Editors. Each PC workstation shall support full screen editing of all system applications. Provide editors for each application at the PC workstation. The applications shall be downloaded and executed at the appropriate controller panels.
  1. Controller. Provide a full screen editor for each type controller and application that shall allow the operator with proper password to view and change the configuration, name, control parameters, and system set-points.
  2. Scheduling. An editor for the scheduling application shall be provided at each workstation. Provide a monthly calendar for each schedule. Exception schedules and holidays shall be shown clearly on the calendar. Provide a method for allowing several related objects to follow a schedule. The advance and delay time for each object shall be adjustable from this master schedule.
    - a. An operator with proper password level shall be able to modify the schedule. Schedules shall be able to be easily copied between objects and/or dates.
    - b. Occupied/Unoccupied schedules shall be individually adjustable for each terminal unit. The user shall be able to easily change the schedule of rooms, etc. An occupied space shall automatically start the unit in normal start up mode.
  3. Equipment Coordination. Provide a full screen editor that allows equipment to be grouped for proper operation as specified in the sequence of operations. This shall include the coordination of VAV boxes with their associated Air Handling Equipment.

4. Custom Application Programming. Provide the tools to create, modify, and debug custom application programming. The operator shall be able to create, edit, and download custom programs at the same time that all other system applications are operating. The system shall be fully operable while custom routines are edited, compiled, and downloaded. The programming language shall have the following features:
  - a. The language shall be English language oriented and be based on the syntax of programming languages such as BASIC. It shall allow for free form or fill in the blank programming. Alternatively, the programming language can be graphically-based using function blocks as long as blocks are available that directly provide the functions listed below, and that custom or compound function blocks can be created.
  - b. A full screen character editor/programming environment shall be provided. The editor shall be cursor/mouse-driven and allow the user to insert, add, modify, and delete code from the custom programming. It shall also incorporate word processing features such as cut/paste and find/replace.
  - c. The programming language shall allow independently executing program modules to be developed. Each module shall be able to independently enable and disable other modules.
  - d. The editor/programming environment shall have a debugging/simulation capability that allows the user to step through the program and to observe any intermediate values and or results. The debugger shall also provide error messages for syntax and execution errors.
  - e. The programming language shall support conditional statements (IF/THEN/ELSE/ELSE-IF) using compound Boolean (AND, OR, and NOT) and/or relations (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
  - f. The programming language shall support floating point arithmetic using the following operators: +, -, /, x, square root, and xy. The following mathematical functions shall also be provided: natural log, log, absolute value, and minimum/maximum value from a list of values.
  - g. The programming language shall have pre-defined variables that represent clock time, day of the week, and date. Variables that provide interval timing shall also be available. The language shall allow for computations using these values.
  - h. The programming language shall have ability to pre-defined variables representing the status and results of the System Software, and shall be able to enable, disable, and change the values of objects in the system.

## 2.6 POWER FAIL RESTART

- A. In the event of the loss of normal power, there shall be an orderly shutdown of the digital panels and workstation to prevent the loss of data base or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data, and battery backup shall be provided to support the clock and all volatile memory for a minimum of 72 hours.
- B. Upon restoration of normal power, the panels shall automatically resume full operation without manual intervention.
- C. Should Digital panel memory be lost for any reason, the user shall have the capability of reloading the panel via the local RS-232 port, or telephone line dial-in.

## 2.7 SYSTEM SOFTWARE

- A. Furnish the following applications software for building and energy management. All software applications shall reside and run in the system controllers. Editing of applications shall occur at the operator workstation.
- B. System Security
  - 1. User access shall be secured using individual security passwords and user names.
  - 2. Passwords shall restrict the user to only the objects, applications, and system functions as assigned by the system manager.
  - 3. User logon/logoff attempts shall be recorded.
  - 4. The system shall protect itself from unauthorized use by automatically logging off following the last keystroke. The delay time shall be user definable.
- C. Scheduling. Provide the capability to schedule each object or group of objects in the system. Each of these schedules shall include the capability for start, stop, optimal start, optimal stop, night setback, and economizer actions. Each schedule may consist of up to 10 events. When a group of objects are scheduled together, provide the capability to define advances and delays for each member. Each schedule shall consist of the following:
  - 1. Weekly Schedule. Provide separate schedules for each day of the week.
  - 2. Exception Schedules. Provide the ability for the operator to designate any day of the year as an exception schedule. This exception schedule shall override the standard schedule for that day. Exception schedules may be defined up to a year in advance. Once an exception schedule is executed it will be discarded and replaced by the standard schedule for that day of the week.
  - 3. Holiday Schedules. Provide the capability for the operator to define up to 99 special or holiday schedules. These schedules may be placed on the scheduling calendar and will be repeated each year. The operator shall be able to define the length of each holiday period.
  - 4. Optimal Start/Stop. The scheduling application outlined above shall support an optimal start/stop algorithm. This shall calculate the thermal characteristics of a zone and start the equipment prior to occupancy to achieve the desired space temperature at the specified occupancy time. The algorithm shall calculate separate sets of heating and cooling rates for zones that have been unoccupied for less than and greater than 24 hours. Provide the ability to modify the start/stop algorithm based on outdoor air temperature. Provide an early start limit in minutes to prevent the system from starting before an operator determined time limit.
- D. Alarm Reporting. The operator shall be able to determine the action to be taken in the event of an alarm. Alarms shall be routed to the appropriate workstations based on time and other conditions. An alarm shall be able to start programs, be logged in the event log, printed, generate custom messages and display graphics.
- E. Remote Communications. The system shall have the ability to dial out in the event of an alarm. Receivers shall include PC Workstations and text messages to cell phones. The alarm message shall include the name of the calling location, the device that generated the alarm, and the alarm message itself. The operator shall be able to remotely access and operate the system using dial up communications.
- F. Demand Limiting.
  - 1. The demand limiting program shall monitor building power consumption from signals generated by a pulse generator provided by others mounted at the building power meter, or from a watt transducer or current transformer attached to the building feeder lines.

2. The demand limiting program shall be based on a predictive sliding window algorithm. The sliding window duration and sampling interval shall be set equal to that of the local Electrical Utility.
  3. Control system shall be capable of demand limiting by resetting HVAC system set-points to reduce load while maintaining Indoor Air Quality (humidity, VOC, CO2) and comfort control in the space.
  4. Input capability shall also be provided for an end-of-billing period indication.
- G. Maintenance Management. The system shall monitor equipment status and generate maintenance messages based upon user designated run time, starts, and/or calendar date limits.
- H. PID Control. A PID (proportional-integral-derivative) algorithm with direct or reverse action and anti-wind-up shall be supplied. The algorithm shall calculate a time-varying analog value used to position an output or stage a series of outputs. The controlled variable, set-point, and PID gains shall be user-selectable. The set-point shall optionally be chosen to be a reset schedule.
- I. Staggered Start. This application shall prevent all controlled equipment from simultaneously restarting after a power outage. The order in which equipment (or groups of equipment) is started, along with the time delay between starts shall be user-selectable.
- J. Anti-Short Cycling. All binary output points shall be protected from short cycling. This feature shall allow minimum on-time and off-time to be selected as noted above for the chillers.

## 2.8 BUILDING CONTROLLERS

- A. General. Provide Building Controllers to provide the performance specified in this section. Each of these panels shall meet the following requirements.
1. The Building Automation System shall be composed of one or more independent, stand-alone, microprocessor based Building Controllers to manage the global strategies described in System software section.
  2. The Building Controller shall have sufficient memory to support its operating system, database, and programming requirements.
  3. The controller shall provide a communications port for connection of a Portable Operators Terminal.
  4. The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.
  5. Data shall be shared between networked Building Controllers.
  6. The Building Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:
    - a. Assume a predetermined failure mode.
    - b. Generate an alarm notification.
- B. Environment. Controller hardware shall be suitable for the anticipated ambient conditions. Controller used in conditioned ambient shall be mounted in an enclosure, and shall be rated for operation at 32 F to 120 F.
- C. Serviceability. Provide diagnostic LEDs for power, communications, and processor. All wiring connections shall be made to field removable, modular terminal strips or to a termination card connected by a ribbon cable.
- D. Memory. The Building Controller shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.

- E. Immunity to power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shut-down below 80% nominal voltage.

## 2.9 CUSTOM APPLICATION CONTROLLERS

- A. General. Provide Custom Application Controllers to provide the performance specified in this specification. Each of these panels shall meet the following requirements.
  - 1. The Building Automation System shall be composed of one or more independent, stand-alone, microprocessor based Building Controllers to manage the local strategies described in System software section.
  - 2. The Controller shall have sufficient memory to support its operating system, database, and programming requirements.
  - 3. The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.
  - 4. Data shall be shared between networked Controllers.
  - 5. The Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:
    - a. Assume a predetermined failure mode.
    - b. Generate an alarm notification.
- B. Environment. Controller hardware shall be suitable for the anticipated ambient conditions.
  - 1. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA Type 4 waterproof enclosures, and shall be rated for operation at  $-40^{\circ}$  F to  $150^{\circ}$  F.
  - 2. Controllers used in conditioned ambient shall be mounted in dust-proof enclosures, and shall be rated for operation at  $32^{\circ}$  F to  $120^{\circ}$  F.
- C. Keypad. A local keypad and display shall be provided where specified below. Keypad shall be provided for interrogating and editing data. An optional system security password shall be available to prevent unauthorized use of the keypad and display. The following controllers shall be furnished with a keypad and LCD or LED display:
- D. Serviceability. Provide diagnostic LEDs for power, communications, and processor. All wiring connections shall be made to field removable, modular terminal strips or to a termination card connected by a ribbon cable.
- E. Memory. The Controller shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.
- F. Immunity to power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shut-down below 80% nominal voltage.

## 2.10 APPLICATION SPECIFIC CONTROLLERS

- A. General. Application specific controllers (ASC) are microprocessor-based DDC controllers which through hardware or firmware design are dedicated to control a specific piece of equipment. They are not fully user programmable, but are customized for operation within the confines of the equipment they are designed to serve.
  - 1. Each ASC shall be capable of stand-alone operation and shall continue to provide control functions without being connected to the network.
  - 2. Each ASC will contain sufficient I/O capacity to control the target system.
- B. Environment. The hardware shall be suitable for the anticipated ambient conditions.

1. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA Type 4 waterproof enclosures, and shall be rated for operation at  $-40^{\circ}$  F to  $150^{\circ}$  F.
  2. Controller used in conditioned ambient shall be mounted in dust-proof enclosures, and shall be rated for operation at  $32^{\circ}$  F to  $120^{\circ}$  F.
- C. Serviceability. Provide diagnostic LEDs for power, and communications. All wiring connections shall be made to field removable, modular terminal strips or to a termination card connected by a ribbon cable.
  - D. Memory. The Application Specific Controller shall maintain all BIOS and programming information in the event of a power loss for at least 90 days.
  - E. Immunity to Power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shut-down below 80%.
  - F. Transformer. Power supply for the ASC must be rated at minimum of 125% of ASC power consumption, and shall be fused or current limiting type.

## 2.11 COMMUNICATIONS

- A. The controls Contractor shall provide all communication media, connectors, repeaters, hubs, and routers necessary for the inter-network.
- B. All Building Controllers shall have a communications port for connections with the operator interfaces.
- C. Communications services over the inter-network shall result in operator interface and value passing that is transparent to the inter-network architecture as follows:
  1. Connection of an operator interface device to any one controller on the inter-network will allow the operator to interface with all other controllers as if that interface were directly connected to the other controllers. Data, status information, reports, system software, custom programs, etc., for all controllers shall be available for viewing and editing from any one controller on the inter-network.
  2. All database values (i.e. points, software variable, custom program variables) of any one controller shall be readable by any other controller on the inter-network. This value passing shall be automatically performed by a controller when a reference to a point name not located in that controller is entered into the controller's database. An operator/installer shall not be required to set up any communications services to perform inter-network value passing.
- D. The time clocks in all controllers shall be automatically synchronized daily.

## 2.12 INPUT/OUTPUT INTERFACE

- A. Hard-wired inputs and outputs may tie into the system through Building, Custom, or Application Specific Controllers.
- B. All input points and output points shall be protected such that shorting of the point to itself, another point, or ground will cause no damage to the controller. All input and output points shall be protected from voltage up to 24V of any duration, such that contact with this voltage will cause no damage to the controller.
- C. Binary inputs shall allow the monitoring of on/off signals or from remote devices. The binary inputs shall provide a wetting current of at least 12 ma to be compatible with commonly available control devices.
- D. Pulse accumulation input points. This type of point shall conform to all the requirements of Binary Input points, and also accept up to 2 pulses per second for pulse accumulation, and shall be protected against effects of contact bounce and noise.



- E. Analog inputs shall allow the monitoring of low voltage (0-10 Vdc), current (4-20 ma), or resistance signals (thermistor, RTD). Analog inputs shall be compatible with, and field configurable to commonly available sensing devices.
- F. Binary outputs shall provide for on/off operation, or a pulsed low voltage signal for pulse width modulation control. Outputs shall be selectable for either normally open or normally closed operation.
- G. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0-10 Vdc or a 4-20 ma signal as required to provide proper control of the output device.

## 2.13 AUXILIARY CONTROL DEVICES

### A. Electronic damper actuators.

1. The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator. Furnish a separate damper actuator for each damper greater than 48" in any dimension.
2. Where shown, for power-failure/safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing.
3. All rotary spring return actuators shall be capable of both clockwise and counter clockwise spring return operation. Linear actuators shall spring return to the retracted position.
4. Proportional actuators shall accept a 0-10 VDC or 0-20 ma control signal and provide a 2-10 VDC or 4-20 ma operating range.
5. All 24 VAC/DC actuators shall not require more than 10 VA for AC or more than 8 W for DC applications. Actuators operating on 120 VAC or 230 VAC shall not require more than 11 VA.
6. All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 in-lb. torque capacity shall have a manual crank for this purpose.
7. All modulating actuators shall have an external, built-in switch to allow the reversing of direction of rotation.
8. Actuators shall be provided with a conduit fitting and a minimum 1m electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.
9. Actuators shall be Underwriters Laboratories Standard 873 listed.
10. Actuators shall be designed for a minimum of 60,000 full stroke cycles at the actuator's rated torque. Actuators shall include a stroke limiting device.

### B. Automatic Dampers (low leakage)

1. Dampers shall include the frame, blades, and linkage assembly. Coordinate damper sizes and quantities with exhaust air fans, plenums, air handling units, and built up air handling units. Dampers shall be as follows:
  - a. Opposed blade configuration and suitable for operating temperatures between -40° F and 200° F.
  - b. The assembly shall include airfoil type blades with the linkage out of the airstream and concealed in the frame.

- c. The seals shall include extruded vinyl blade edge seals and flexible metal compression type jamb seals. Bearings shall be stainless steel sleeve. The axles shall be 1/2" plated steel hex.
  - d. The Damper shall be constructed of a minimum of 16 gauge galvanized steel.
  - e. Damper shall have a maximum leakage performance rating of 4 cfm per square foot at 1 inch water gauge static pressure differential (based on a 36 "wide x 24" high damper).
  - f. Dampers shall bear the AMCA certification for air leakage.
  - g. Low leakage dampers shall be by Ruskin or approved equal.
- 2. Reference the drawings for minimum and economizer outdoor air damper sizes.
  - 3. Submit product data, performance and installation data. Clearly indicate profile of damper size, materials, damper blade configuration, damper linkage, leakage characteristics and operators.
- C. Sensors:
- 1. Room and duct humidity sensors shall be of the thin film capacitance type containing a humidity sensitive material that modifies its dielectric constant to maintain accuracy of + 5% RH @ 77° F, range of 20% to 95% RH, including hysteresis, linearity, and repeatability. The sensor shall be rated for operation between 15 to 170 degrees F. Sensors must be sensor well mounted. Strap on or adhesive type sensors will not be accepted.
  - 2. All temperature and humidity sensors shall be of the electronic type. The temperature sensors shall be resistance temperature device (RTD) or thermistor type.
    - a. Room sensors shall include covers for horizontal or vertical mounting and concealed adjustments. Sensors shall include adjustable slide temperature sensors, and two-hour push button override. All wall sensors located on exterior walls or surfaces that will cause abnormal sensor readings shall be furnished with an insulated base.
    - b. Room sensors shall have a range of 32-120 degrees F with a factory calibration of 74 F. Accuracy shall be plus or minus 1 degree F at calibration point.
    - c. Duct Temperature Sensors - accuracy of + 1° F @ 77 deg F. Duct air sensors shall be duct single point, averaging probe or averaging bulb as required under sequence of operation.
    - d. Use insertion elements with a brass well with a minimum length of 2.5"
    - e. Outside air sensor shall have watertight inlet fitting and contain a shield from direct sunlight.
  - 3. Duct pressure sensors shall be compatible for use in HVAC air distribution or air handling systems and shall have an accuracy of plus or minus .1" w.g. Sensors shall have an operating temperature range from 0-175° F and 10-90% relative humidity. Sensors shall be Mamac Systems or approved equal.

- D. Low Temperature Detection
  - 1. Electric low temperature warning thermostats shall have 20 ft low point sensitive elements (not averaging type) installed in parallel or series to serpentine the entire coil face area of the chilled water coil. These thermostats shall be two position reset type. Where coils are in banks, multiple low limit thermostats, wired in series, shall be provided and wired to initiate the freeze condition sequences specified and signal a remote alarm to the facilities management console.
  - 2. The low temperature thermostat shall be manual reset type as described in the sequence of operations.
  - 3. Thermostat shall be adjustable between the temperatures of 35° to 45° F.
- E. Current Sensing Relays - shall be split core type with adjustable high and low trip settings. Range shall not exceed 175% of expected input. Coordinate special requirements for systems with variable speed drives.
- F. Flow Switches
  - 1. Flow-proving switches shall be either paddle or differential pressure type for proof of flow application.
  - 2. Paddle type switches (water service only) shall be UL listed, SPDT snap-acting with pilot duty rating (125 VA minimum). Adjustable sensitivity with NEMA Type 1 enclosure unless otherwise specified:
  - 3. Differential pressure type switches (air or water service) shall be UL listed, solid state, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA Type 1 enclosure, with scale range and differential suitable for intended application, or as specified. Mercoïd type switches shall not be used for equipment that vibrates such as chillers, etc. Differential pressure switches shall be by Orange Research or approved equal.
  - 4. Current sensing relays may be used for flow sensing or terminal devices.
- G. Relays
  - 1. Control relays shall be UL listed plug-in type with dust cover. Contact rating, configuration, and coil voltage suitable for application.
  - 2. Time delay relays shall be UL listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable plus or minus 200% (minimum) from set-point shown on plans. Contact rating, configuration, and coil voltage suitable for application. Provide NEMA Type 1 enclosure when not installed in local control panel.
- H. Transformers and Power Supplies
  - 1. Control transformers shall be UL listed, Class 2 current-limiting type, or shall be furnished with over-current protection in both primary and secondary circuits for Class 2 service.
  - 2. Unit output shall match the required output current and voltage requirements. Current output shall allow for a 50% safety factor. Output ripple shall be 3.0 mV maximum Peak-to-Peak. Regulation shall be 0.10% line and load combined, with 50 microsecond response time for 50% load changes. Unit shall have built-in over-voltage protection.
  - 3. Unit shall operate between 0° C and 50° C.
  - 4. Unit shall be UL recognized.
- I. Local Control Panels
  - 1. All indoor control cabinets shall be fully enclosed NEMA Type 1 construction with hinged door, key-lock latch, removable sub-panels. A single key shall be common to all field panels and sub-panels.

2. Interconnections between internal and face-mounted devices pre-wired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL listed for 600-volt service, individually identified per control/interlock drawings, with adequate clearance for field wiring. Control termination's for field connection shall be individually identified per control drawings.
  3. Provide on/off power switch with over-current protection and main air gauge for control power sources to each local panel.
- J. Auxiliary Devices
1. Furnish and install all necessary auxiliary electronic devices as appropriate to accomplish the sequence as specified. These totally electronic devices shall include (but not be limited to) such items as load limiting controllers, low signal selectors, high signal selectors, remote reset control devices, floating alarm units, staging networks, damper position indicators, unison amplifiers, reversing networks, sequencing networks and electronic power supplies.
- K. Smoke Detectors
1. The smoke detectors for air handling units shall be furnished and installed by the electrical contractor.

#### 2.14 AIR FLOW MONITORING DEVICES (AT FAN INLETS)

- A. Furnish fan inlet airflow probes to traverse the inlet of a fan. The probe shall be capable of continuously measuring the air handling unit air volume for the respective fan. Coordinate the number of inlets required with fan type indicated on the drawings.
- B. The probes shall not adversely affect the performance of the fan and shall have an accuracy of 3% of the actual flow based on a 6:1 turndown ratio.
- C. Probes shall be VOLU-probe FI by Air Monitor Corporation or engineer approved equivalent.

#### 2.15 WIRING

- A. All electric wiring required for the control system and any interlock wiring required for the controls sequence shall be provided by the Temperature Control Contractor.
- B. All line voltage control wiring shall be run in conduit. Reference Division 26 for requirements.
- C. Wire shall be a minimum of #18 gauge, color coded, stranded wire for all low voltage, electronic circuit with "spares" installed (one for every group of 10 wires) in conduit.
- D. Coordinate the requirements for 120V circuits for the ASC's. All control transformers shall be the responsibility of this contractor. Reference the electrical drawings for circuit locations.

### **PART 3 EXECUTION**

#### 3.1 INSTALLATION

- A. Install wiring in a neat and workmanlike manner. Wiring to finished spaces shall be run concealed.
- B. All work is to be installed by a qualified person skilled in the installation of electronic control systems. The control company representative is responsible for the proper installation of the control system and will provide supervision of the installation.
- C. Install damper actuators for all automatic dampers.
- D. Install terminal equipment controllers on terminal boxes and provide all necessary control wiring.

- E. Install system and materials in accordance with manufacturer's instructions and roughing -in drawings, and details and drawings. Install electrical work and use electrical products complying with requirements of applicable Division 26 sections of these specifications. Mount controllers at convenient locations and heights.
- F. Check and verify location of thermostats with plans and room details before installation. Install thermostats 48 inches above floor to meet the Americans with Disabilities Act (ADA). Align with lighting switches and humidistats.
- G. Wiring. The term "wiring" is defined to include providing of wire, conduit and miscellaneous materials as required for mounting and connecting electric control devices.
- H. Wiring System. Install complete wiring system for electric-electronic temperature controls. Conceal wiring, except in mechanical rooms and areas where other conduit and piping are exposed. Provide multi-conductor instrument harness (bundle) in place of single conductors where number of conductors can be run along common path. Fasten flexible conductors bridging cabinets and doors, neatly along hinge side, and protect against abrasion. Tie and support conductors neatly.
- I. Number-code or color-code conductors, appropriately for future identification and servicing of control system.

### 3.2 ON-SITE TESTING

- A. Provide Engineer and/or Owner approved operation and acceptance testing of the complete system. The Engineer and/or Owner will witness all tests.
- B. Field Test. When installation of the system is complete, calibrate equipment and verify transmission media operation before the system is placed in line. All testing, calibrating, adjusting and final field tests shall be completed by the installer. Provide a cross-check of each control point within the system by making a comparison between the control command and the field-controlled device. Verify that all systems are operable from local controls in the specified failure mode upon panel failure or loss of power. Submit the results of functional and diagnostic tests and calibrations to the Engineer for final system acceptance.
- C. Compliance Inspection Checklist. Submit in the form requested, the following items of information to the Owner's representative and Architect/Engineer for verification of compliance to the project specifications. Failure to comply with the specified information shall constitute non-performance of the contract. The contractor shall submit written justification for each item in the checklist that he is unable to comply with. The Owner's Representative and the Architect/Engineer will initial and date the checklist to signify Contractor's compliance before acceptance of system.
  - 1. Verify to the Owner's Representative and Architect/Engineer in letter form that supplier has in-place support facility. Letter shall show location of support facility, name and titles of technical staff, engineers, supervisors, fitters, electricians, managers and all other personnel responsible for the completion of the work on this project  
 User \_\_\_\_\_ Date \_\_\_\_\_ A/E \_\_\_\_\_ Date \_\_\_\_\_
  - 2. Manually generate an alarm at the remote DDC Controller as selected by the Architect/Engineer to demonstrate the capability of the workstation and alarm printer to receive alarms within 5 seconds.  
 User \_\_\_\_\_ Date \_\_\_\_\_ A/E \_\_\_\_\_ Date \_\_\_\_\_
  - 3. Disconnect one DDC Controller from the network to demonstrate that a single device failure shall not disrupt or halt peer-to-peer communication. Panel to be disconnected shall be selected by the Architect/Engineer.  
 User \_\_\_\_\_ Date \_\_\_\_\_ A/E \_\_\_\_\_ Date \_\_\_\_\_

4. At a DDC Controller of the Architect/Engineer's choice, display on the portable operator's terminal:
  - a. At least one temperature setpoint and at least one status condition; i.e.: on or off for a system or piece of equipment attached to the panel as well as for points at another DDC Controller on the network.
  - b. The diagnostic results as specified for a system or piece of equipment attached to that panel as well as for a system or piece of equipment attached to another DDC Controller.
  - c. The ability to add a new point to the DDC Controller with the POT and have it automatically uploaded to the workstation to modify that panel's stored database.  
 User \_\_\_\_\_ Date \_\_\_\_\_ A/E \_\_\_\_\_ Date \_\_\_\_\_
5. At the Architect/Engineer's choice, disconnect the trunk connection to demonstrate its lack of reliance on a DDC Controller to maintain full control functionality.  
 User \_\_\_\_\_ Date \_\_\_\_\_ A/E \_\_\_\_\_ Date \_\_\_\_\_

### 3.3 SERVICE AND GUARANTEE

- A. General Requirements. Provide all services, materials and equipment necessary for the successful operation of the entire BAS System for a period of one year after completion of successful performance test. Provide necessary material required for the work. Minimize impacts on facility operations when performing scheduled adjustments and non-scheduled work.
- B. Description of Work. The adjustment and repair of the system includes all computer equipment, software updates, transmission equipment and all sensors and control devices. Provide the manufacturer's required adjustment and all other work necessary.
- C. Personnel. Provide qualified personnel to accomplish all work promptly and satisfactorily. Owner shall be advised in writing of the name of the designated service representative, and of any changes in personnel.
- D. Schedule of Work. Provide two minor inspections at 6 month intervals and two major inspections offset equally between the minor inspections to effect quarterly inspection of alternating magnitude, and all work required as specified. Schedule major inspections in July and January. Minor inspections shall include visual checks and operational test of all equipment delivered. Major inspections shall include all work described for minor inspections and the following work:
  1. Clean all equipment, including interior and exterior surfaces.
  2. Perform signal, voltage and system isolation checks of system workstations and peripherals.
  3. Check and calibrate each field device. Check all analog points and digital points.
  4. Run all diagnostics and correct all previously diagnosed problems.
  5. Resolve and correct any previous outstanding problems.
- E. Emergency Service. Owner shall initiate service calls when the system is not functioning properly. Qualified personnel shall be available to provide service to the complete system. Furnish Owner with a telephone number where service representative can be reached at all times. Service personnel shall be at the site within 4 hours after receiving a request for service. Restore the control system to proper operating condition within 24 hours.
- F. Operation. Performance of scheduled adjustment and repair shall verify operation of the system as demonstrated by the initial performance test.

- G. Systems Modifications. Provide any recommendations for system modification in writing to Owner. Do not make any system modifications, including operating parameters and control settings, without prior approval of Owner. Any modifications made to the system shall be incorporated into the operations and maintenance manuals, and other documentation affected.
- H. Software. Provide all software updates and verify operation in the system. These updates shall be accomplished in a timely manner, fully coordinated with the system operators, and shall be incorporated into the operations and maintenance manuals, and software documentation.

### 3.4 EXAMINATION

- A. The project plans shall be thoroughly examined for control device and equipment locations, and any discrepancies, conflicts, or omissions shall be reported to the Architect/Engineer for resolution before rough-in work is started.

### 3.5 GENERAL WORKMANSHIP

- A. Install equipment, piping, wiring/conduit parallel to building lines (i.e. horizontal, vertical, and parallel to walls) wherever possible.
- B. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
- C. Install all equipment in readily accessible location as defined by chapter 1 article 100 part A of the NEC. Control panels shall be attached to structural walls unless mounted in equipment enclosure specifically designed for that purpose. Panels shall be mounted to allow for unobstructed access for service.
- D. Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.
- E. All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.
- F. Coordinate with the testing and balancing contractor to adjust low leakage dampers if damper leak rate exceeds specifications.

### 3.6 INSTALLATION OF SENSORS

- A. Install sensors in accordance with the manufacturer's recommendations.
- B. Mount sensors rigidly and adequate for the environment within which the sensor operates.
- C. Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing.
- D. All wires attached to sensors shall be air sealed in their conduits or in the wall to stop air transmitted from other areas affecting sensor readings.
- E. Install duct static pressure tap with tube end facing directly down-stream of airflow.
- F. Sensors used in mixing plenums, and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip.
- G. All pipe mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat conducting fluid in thermal wells.
- H. Wiring for space sensors shall be concealed in building walls. EMT conduit is acceptable within mechanical and service rooms.
- I. Install outdoor air temperature sensors on north wall complete with sun shield at designated location.

### 3.7 FLOW SWITCH AND PRESSURE DIFFERENTIAL SWITCH INSTALLATION

- A. Install using a thread-o-let in steel pipe. In copper pipe use C x C x F Tee, no pipe extensions or substitutions allowed.
- B. Mount a minimum of 5 pipe diameters up stream and 5 pipe diameters downstream or 2 feet which ever is greater, from fittings and other obstructions.
- C. Install in accordance with manufacturers instructions.
- D. Assure correct flow direction and alignment.
- E. Mount in horizontal piping - flow switch on top of the pipe.
- F. Pressure differential switches mounted on horizontal sections of pipe shall be installed on the side or top of pipes to avoid accumulation of debris.

### 3.8 ACTUATORS

- A. Mount and link control damper actuators per manufacturer's instructions.
- B. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
- C. Valves - Actuators shall be mounted on valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following manufacturer's recommendations.

### 3.9 WARNING LABELS

- A. Affix plastic labels on each starter and equipment automatically controlled through the Control System including all air handling unit fans at doors. Label shall indicate the following:

#### C A U T I O N

This equipment is operating under  
automatic control and may start at  
any time without warning.

### 3.10 IDENTIFICATION OF HARDWARE AND WIRING

- A. All wiring and cabling, including that within factory-fabricated panels, shall be labeled at each end within 2" of termination with a cable identifier and other descriptive information.
- B. Permanently label or code each point of field terminal strips to show the instrument or item served.
- C. Identify control panels with minimum 1 cm letters on laminated plastic nameplates.
- D. Identify all other control components with permanent labels. Identifiers shall match record documents All plug-in components shall be labeled such that removal of the component does not remove the label.

### 3.11 CONTROLLERS

- A. Provide a separate Controller for each major piece of HVAC equipment. Points used for control loop reset such as outside air or space temperature are exempt from this requirement.
- B. Building Controllers and Custom Application Controllers shall be selected to provide a minimum of 15% spare I/O point capacity for each point type found at each location. If input points are not universal, 15% of each type is required. If outputs are not universal, 15% of each type is required. A minimum of one spare is required for each type of point used.



- C. Future use of spare capacity shall require providing the field device, field wiring, point database definition, and custom software. No additional Controller boards or point modules shall be required to implement use of these spare points.

### 3.12 PROGRAMMING

- A. Provide sufficient internal memory for the specified control sequences and trend logging. There shall be a minimum of 25% of available memory free for future use.
- B. Point Naming. System point names shall be modular in design, allowing easy operator interface without the use of a written point index.
- C. Software Programming
  - 1. Provide programming for the system as per specifications and adhere to the strategy algorithms provided. All other system programming necessary for the operation of the system but not specified in this document shall also be provided by the Control System Contractor. Imbed into the control program sufficient comment statements to clearly describe each section of the program. The comment statements shall reflect the language used in the sequence of operations.
- D. Operators' Interface
  - 1. Standard Graphics. Provide graphics for each major piece of equipment and floor plan in the building. This includes Air Handlers and mini split systems. These standard graphics shall show all points dynamically as specified in the points list.
  - 2. The controls contractor shall provide all the labor necessary to install, initialize, start-up, and trouble-shoot all operator interface software and their functions as described in this section. This includes any operating system software, the operator interface data base, and any third party software installation and integration required for successful operation of the operator interface.
  - 3. As part of this execution phase, the controls contractor will perform a complete test of the operator interface. Test duration shall be a minimum of 16 hours on-site. Tests shall be made in the presence of the Owner or Owner's representative.
- E. Demonstration. A complete demonstration and readout of the capabilities of the monitoring and control system shall be performed. The contractor shall dedicate a minimum of 4 hours on-site with the Owner and his representatives for a complete functional demonstration of all the system requirements. This demonstration constitutes a joint acceptance inspection, and permits acceptance of the delivered system for on-line operation.

### 3.13 CLEANING

- A. This contractor shall clean up all debris resulting from his or her activities daily. The contractor shall remove all cartons, containers, crates, etc. under his control as soon as their contents have been removed. Waste shall be collected and placed in a location designated by the Construction Manager or General Contractor.
- B. At the completion of work in any area, the Contractor shall clean all of his/her work, equipment, etc., making it free from dust, dirt and debris, etc.
- C. At the completion of work, all equipment furnished under this Section shall be checked for paint damage, and any factory finished paint that has been damaged shall be repaired to match the adjacent areas. Any metal cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

### 3.14 PROTECTION

- A. The Contractor shall protect all work and material from damage by his/her work or workers, and shall be liable for all damage thus caused.
- B. The Contractor shall be responsible for his/her work and equipment until finally inspected, tested, and accepted. The Contractor shall protect his/her work against theft or damage, and shall carefully store material and equipment received on site that is not immediately installed. The Contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

### 3.15 FIELD QUALITY CONTROL

- A. All work, materials and equipment shall comply with the rules and regulations of applicable local, state, and federal codes and ordinances as identified in Part 1 of this Section.
- B. Contractor shall continually monitor the field installation for code compliance and quality of workmanship. All visible piping and or wiring runs shall be installed parallel to building lines and properly supported.
- C. Contractor shall arrange for field inspections by local and/or state authorities having jurisdiction over the work.

### 3.16 ACCEPTANCE

- A. The control systems will not be accepted as meeting the requirements of Completion until all tests described in this specification have been performed to the satisfaction of both the Engineer and Owner. Any tests that cannot be performed due to circumstances beyond the control of the Contractor may be exempt from the Completion requirements if stated as such in writing by the Owner's representative. Such tests shall then be performed as part of the warranty.

**END OF SECTION 23 0900**

SECTION 23 11 23  
FACILITY NATURAL GAS PIPING

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Provide equipment, materials, tools, labor, and supervision necessary to furnish, fabricate, and install a complete Natural Gas piping system.

1.2 STANDARDS AND CODES

- A. Pipe materials specified in this Section shall apply to technical sections of Division 23 of the Project Manual where applicable. Special requirements as may be called for in the technical sections, or shown on the Drawings, shall take precedence over General Requirements herein. Piping located in plenums shall be plenum rated for fire and smoke.
- B. Gas piping and connections to equipment shall be in accordance with NFPA-54 and the City of Johnston Gas Code and the local utility company.

1.3 PRODUCT HANDLING

- A. Provide factory-applied plastic end-caps on each length of pipe and tube. Maintain end-caps through shipping, storage, and handling as required to prevent pipe-end damage and eliminate dirt and moisture from inside of pipe and tube.
- B. Where possible, store pipe and tube inside and protected from weather. Where necessary to store outside, elevate well above grade and enclose with durable, waterproof wrapping.
- C. Protect flanges and fittings from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

1.4 SUBMITTALS

- A. Submit piping schedule listing each pipe material used and systems served.
- B. Submit shop drawings at ¼" per foot scale indicating exact routing and elevations for all piping systems.

**PART 2 PRODUCTS**

2.1 MATERIAL

- A. Material and Service
- B. Aboveground natural gas.
  - 1. Black steel pipe seamless, Schedule 40, ASTM A53.
- C. Fittings
  - 1. Threaded pipe - malleable iron fittings, 125-pound standard flat band water pattern.
  - 2. Welded pipe - welded neck fittings and welded neck flanges, same material and strength as pipe.
  - 3. Carbon steel pipe - material and strength shall correspond to pipe specifications. ANSI B31.5.

#### D. Joints

1. Threaded pipe - make joints using approved pipe joint compound, applied to male threads only. Cut pipe square, cut threads clean, remove burrs, and ream ends to full size of bore. Threads shall not be exposed on chromium-plated pipe.
2. Welded pipe - welding shall conform to welding section of ANSI B31.1 "Code for Power Piping". Pipe up to 2" diameter shall be screwed. Pipe 2 ½" diameter and over shall be welded.

#### E. Nipples and Unions

1. Nipples shall conform to size, weight, and strength of adjoining pipe. When length of unthreaded portion of nipple is less than 1-1/2", use extra strong nipple; do not use close nipples.
2. For pipe 3" and smaller, use screwed unions; over 3", use flanged unions. For steel and wrought iron pipe, use malleable iron ground joint unions, black or galvanized, to conform to pipe. Cast iron flanged unions are to be gasket type. For threaded brass pipe, use bronze ground joint unions with octagon ends. Install unions on equipment intended to be disassembled.
3. Dielectric unions shall be installed between connections of copper pipe and ferrous piping.

### 2.2 PLUG VALVES

- A. Plug valves shall not be furnished unless specifically shown on the Drawings. When so indicated, this type of valve shall meet the following specifications:
1. Smaller than 2 in.: Tapered plug valves, semi-steel, screwed, wrench operated with wrench.
  2. 2 in. and larger: Tapered plug valves, carbon steel, flanged, lubricated plug wrench operated with a wrench.

### 2.3 PRESSURE REGULATING VALVE (NATURAL GAS)

- A. Gas regulators shall be furnished and installed to maintain the gas pressure to the pilot supply and main burner supply line within +10% of the operating pressure from maximum to minimum firing rates at inlet operating pressures of 1-1/2 to 2 psig.
- B. Regulators shall be of the spring-loaded or pressure balanced type. Under no circumstances shall a dead weight or a weight and level type of regulator be used.
- C. Gas regulators shall be suitable for operation with electronic ignition "dead end" conditions.
- D. Gas pressure regulators shall be AGA and CGA certified for scheduled operating conditions.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install piping and make service connection as shown on the Drawings.
- B. Pipe size 2 in. and larger or 2 psig and greater shall have welded joints; pipe less than 2 in. and less than 2 psig shall have threaded joints made up with gas resistant joint compound.
- C. Install gas shutoff plug valve in main, in each branch line and at each appliance.
- D. Install service plug valve at each outlet.

- E. General: Comply with requirements of basic piping material sections for installation of piping materials. Install piping products in accordance with manufacturer's written instructions, with applicable installation requirements of ANSI Z 223.1, and in accordance with recognized industry practices so that products serve intended functions.
- F. Use sealants on metal gas piping threads that are chemically resistant to LP and natural gas. Use sealants sparingly and apply to only male threads of metal joints.
- G. Remove cutting and threading burrs before assembling piping.
- H. Do not install defective piping or fittings. Do not use pipe with threads that are chipped, stripped or damaged.
- I. Plug each gas outlet, including valves, with a threaded plug or cap immediately after installation, and retain until continuing piping or equipment connections are completed.
- J. Install dirt-legs in gas piping at connections to equipment and elsewhere as indicated, and where required by code or regulation.
- K. Install tee fittings with bottom outlet plugged, or capped, at bottom of pipe risers.
- L. Do not install gas piping through foundations or under buildings. Where unavoidable, install in welded conduit, ventilated to outdoors on both ends, and tested to same requirements as gas piping.
- M. Gas piping shall be electrically grounded and continuously grounded within the project and bonded tightly to the grounding connection.
- N. Use dielectric unions where dissimilar metals are joined together.
- O. Install piping with 1/64" per foot (1/8%) downward slope in direction flow.
- P. Install piping parallel to other piping, but maintain minimum of 12" clearance between gas piping and steam or hydronic piping above 200° F (93° C).
- Q. Gas Service:
  - 1. General: Arrange with utility company to provide gas service to indicated location with shutoff at terminus. Consult with utility as to extent of its work, costs, fees and permits involved. Pay such costs and fees; obtain permits.
  - 2. Extend service pipe from utility's terminus to inside building wall, under utility's direction.
  - 3. Provide shutoff outside building where indicated. Provide shutoff in gas service pipe at entry in building.
- R. Installation of Valves:
  - 1. Gas Cocks: Provide at connection to gas train for each gas-fired equipment item; and on risers and braces where indicated.
  - 2. Locate gas cocks where easily accessible, and where they will be protected from possible injury.
  - 3. Pressure Regulating Valves: Install where shown and where required; comply with Utility requirements. Pipe atmospheric vent to outdoors, full size of outlet. Install gas shutoff valve upstream of each pressure regulating valve.

### 3.2 EQUIPMENT CONNECTIONS

- A. Fuel Gas Piping Tightness Test: Prior to initial operation, test and purge fuel gas piping in accordance with ANSI Z 223.1, National Fuel Gas Code.
- B. General: Connect gas piping to each gas-fired equipment item, with dirt leg and shutoff gas cock and pressure regulator where required. Comply with equipment manufacturer's instructions.

C. Piping Tests:

1. Using dry nitrogen, purge each segment to be tested. Cap or otherwise seal the segment to be tested. Fill system with dry nitrogen and test in accordance with NFPA 54.
2. Repair or replace fuel gas piping as required to eliminate leaks, and retest as specified to demonstrate compliance.
3. All welded pipe shall be pressure tested to 90 psig for a minimum period of one hour. Submit test results.

D. Purge System:

1. After all segments have been tested and entire system completed, purge the system free of air in accordance with NFPA 54. Do not leave purge discharge points unattended.

E. Spare Parts:

1. Furnish to Owner, with receipt, 2 valve wrenches for each type of gas valve installed, requiring same.

**END OF SECTION 23 1123**

SECTION 23 23 00  
REFRIGERANT PIPING

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Provide equipment, materials, tools, labor, and supervision necessary to furnish, fabricate, and install complete piping system.

1.2 STANDARDS AND CODES

- A. Pipe materials specified in this Section shall apply to technical sections of Division 23 of the Project Manual where applicable. Special requirements as may be called for in the technical sections, or shown on the Drawings, shall take precedence over General Requirements herein. Piping located in plenums shall be plenum rated for fire and smoke.

1.3 PRODUCT HANDLING

- A. Provide factory-applied plastic end-caps on each length of pipe and tube. Maintain end-caps through shipping, storage, and handling as required to prevent pipe-end damage and eliminate dirt and moisture from inside of pipe and tube.
- B. Where possible, store pipe and tube inside and protected from weather. Where necessary to store outside, elevate well above grade and enclose with durable, waterproof wrapping.
- C. Protect flanges and fittings from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

1.4 SUBMITTALS

- A. Submit piping schedule listing each pipe material used and systems served.
- B. Submit shop drawings at 1/4" per foot scale indicating exact routing and elevations for all piping systems.

**PART 2 PRODUCTS**

2.1 MATERIAL

- A. Material and Service
- B. Copper refrigeration tube, hard temper, Type L-ACR, ASTM B88: Refrigerant lines.
- C. Welded carbon steel, Schedule 80, ASTM A106.: Ammonia liquid lines. Up to and including 1-1/2" diameter.
- D. Fittings
  - 1. Copper water tube, cast bronze or wrought copper, solder joint type. ANSI B16.18 and B16.22.
  - 2. Carbon steel pipe - material and strength shall correspond to pipe specifications. ANSI B31.5.

#### E. Joints

1. Copper water and drainage tube - use 95-5 tin antimony or silver solder, cut pipe square, clean and polish tube ends and inner surface of fittings, apply flux and solder joint as recommended by manufacturer of solder type fittings. Use same methods for copper refrigerant pipe, except use silver solder with 15% silver content, equivalent to Sil-Flos 15.
2. Welded pipe - welding shall conform to welding section of ANSI B31.1 "Code for Power Piping". Pipe up to 2" diameter shall be screwed. Pipe 2 ½" diameter and over shall be welded.

#### F. Nipples and Unions

1. Nipples shall conform to size, weight, and strength of adjoining pipe. When length of unthreaded portion of nipple is less than 1-1/2", use extra strong nipple; do not use close nipples.
2. For pipe 3" and smaller, use screwed unions; over 3", use flanged unions. For steel and wrought iron pipe, use malleable iron ground joint unions, black or galvanized, to conform to pipe. Install unions on equipment intended to be disassembled.
3. Dielectric unions shall be installed between connections of copper pipe and ferrous piping.

### 2.2 REFRIGERATION ACCESSORIES

- A. Refrigerant Liquid Line Filter Driers: Provide refrigerant liquid line drier as recommended by equipment manufacturer for use in service indicated.
- B. Solenoid Valves: Provide solenoid valves of type, size, and rating as recommended by equipment manufacturer for use in service indicated.
- C. Moisture-Liquid Indicators: Provide moisture-liquid indicators as recommended by equipment manufacturer for use indicated, double port, color-coded, U.L. listed.
- D. Thermal Expansion Valves: Provide thermal expansion valves of type, size, and rating as recommended by equipment manufacturer for use in service indicated.
- E. Strainers: 500 psig maximum working pressure; forged brass body with Monel 80-mesh screen, and screwed cleanout plug; Y-pattern, with solder end connections.
- F. Provide UL listed valves (globe, check, hot gas by-pass, etc.) where required or recommended by manufacturer.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install pipe for plumbing and mechanical systems as shown on the Drawings, as called for in other Sections, and as specified herein.
- B. Arrange and install piping approximately as indicated, straight, plumb, and as direct as possible, form right angles on parallel lines with building walls. Keep pipes close to walls, partitions, and ceilings, offsetting only where necessary to follow walls and avoid interference with other mechanical items. Locate groups of pipes parallel to each other; space at a distance to permit applying full insulation and to permit access for servicing valves. Piping to be run in concealed locations unless indicated exposed, or in equipment rooms.
- C. Install horizontal piping as high as possible without sags or humps so that proper grades can be maintained for drainage. Branch piping shall come off the tops of mains unless shown otherwise.



- D. Locate valves within reachable distance from equipment being served for easy access and operation. Do not locate valves with stems below horizontal.
- E. Check piping for interference with other trades.
- F. Where rough-ins are required for equipment furnished by others, verify exact rough-in dimensions with Owner or equipment supplier before roughing-in.
- G. Install automatic temperature control valves, separable wells, pressure taps, and other items as called for and furnished by the temperature controls section.
- H. 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.
- I. 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.
- J. Before installation of steel refrigerant piping, clean pipe and fittings using the following procedures:
  - 1. Shot blast the interior of piping.
  - 2. Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through tubing by means of a wire or electrician's tape.
  - 3. Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.
  - 4. Draw a clean, lintless cloth, saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint. Inspect tube or pipe visually for remaining dirt and lint.
  - 5. Finally, draw a clean, dry, lintless cloth through the tube or pipe.
  - 6. Safety-relief-valve discharge piping is not required to be cleaned but is required to be open to allow unrestricted flow.

### 3.2 INSTALLATION OF REFRIGERATION ACCESSORIES

- A. Refrigerant Liquid Line Filter Driers: install in refrigerant liquid lines as indicated, and in accessible location for service. Provide with valve bypass.
- B. Solenoid Valves: Install in refrigerant piping as indicated with stem pointing upwards.
- C. Moisture-Liquid Indicators: Install as indicated on refrigerant liquid lines, in accessible locations.
- D. Thermal Expansion Valves: Install in refrigerant piping as indicated.
- E. Install strainers immediately ahead of each expansion valve, solenoid valve, hot gas bypass valve, compressor suction valve, and as required to protect refrigerant piping system components.

**END OF SECTION 23 2300**

SECTION 23 31 13  
METAL DUCTS

**PART 1 GENERAL**

1.1 SUMMARY

- A. Provide material, devices, labor, and supervision necessary to fabricate and erect ductwork as required by the Drawings and this Section.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for metal ductwork materials and products.
- B. Shop Drawings: Submit ductwork shop drawings for entire facility, to scale, double line, indicating duct sizes, locations, fittings, equipment, accessories, structural clearances, etc. Do not install ductwork prior to approval of shop drawings by Engineer.
- C. Duct Leakage Test Reports: Submit test report to Engineer and include in O&Ms. Indicate sections tested, test pressure, leakage rate and highlight duct sections that were tested.

1.3 QUALITY ASSURANCE

- A. Codes and Standards:
  - 1. Ducts, plenums, apparatus casings, metal gauges, reinforcing, methods of supporting and hanging, and other sheet metal work as called for shall meet all functional criteria defined in Section VII, of the SMACNA "HVAC Duct Construction Standards Metal and Flexible" latest edition. This shall be subsequently referred to as the SMACNA Manual. All ductwork must comply with all local, state and federal code requirements.
  - 2. Comply with applicable requirements of NFPA 91.

1.4 DESCRIPTION

- A. Air ducts shall be constructed as follows:
  - 1. Supply duct +3" w-g.
  - 2. Miscellaneous duct (exhaust, transfer grille, etc.) ±2" w-g.
  - 3. Return duct ±2" w-g.
  - 4. OA ducts and plenums ±3" w-g.

**PART 2 PRODUCTS**

2.1 GENERAL

- A. Shop fabricated sheet metal work shall be constructed of prime quality re-squared tight coat galvanized steel, except where other type material is specified. Manufacturer's name and U.S. gauge number shall appear on each sheet.
- B. Duct sealant shall be installed per SMACNA Class A-all transverse joints, longitudinal seams and duct wall penetrations.

- C. Duct Sealant for Low Pressure Duct: UL labeled non-hardening, non-migrating mastic or liquid elastic sealant, type applicable for fabrication/installation detail, as compounded and recommended by manufacturer specifically for sealing joints and seams in ductwork. Sealant to be Mastic No. IG601 as manufactured by Hardcast or Engineer approved equivalent product manufactured by Ductmate or United McGill.
- D. Duct sealing tape and adhesive for high-pressure duct system by Hardcast Inc. or Engineer approved equivalent.
  - 1. Use Hardcast DT or JT pressureless tape in conjunction with Hardcast adhesive FTA20 on all fittings and joint connections.
  - 2. Use FTA20 full strength. Dip Hardcast tape in solution until saturated.
  - 3. Apply two wraps of wet tape on duct joint sections and fittings. Stretch tight to assure positive adhesion contact with the duct and to smooth out wrinkles.
  - 4. Follow manufacturer's written instructions.
- E. Round and/or oval ducts and fittings shall be as manufactured by Semco or United McGill.

## 2.2 DUCT

- A. Rectangular Duct:
  - 1. Sheet Metal: Except as otherwise indicated, fabricate ductwork and fittings from minimum 24 gage galvanized sheet steel complying with ASTM A527, lock forming quality; with G90 zinc coating in accordance with ASTM A653; and mill phosphatized for exposed locations.
  - 2. Rectangular duct shall be fabricated to the SMACNA functional criteria for the pressure class indicated on the Drawings.
  - 3. Pittsburgh lock shall be used on all longitudinal seams. All longitudinal seams will be sealed with mastic sealant. Snaplock is not acceptable.
- B. Rectangular Duct Fittings:
  - 1. Elbows shall be constructed with centerline radius of not less than 1.5 times duct width; where space conditions will not permit this radius or where indicated on the Drawings, square elbows with single thickness streamline turning vanes shall be used. Provide trailing edge extension for elbows in series.
  - 2. Slopes for transitions or other changes in dimension shall be minimum 1 to 3.
  - 3. All duct seams and joints shall be sealed to SMACNA Class A requirements.
  - 4. Rectangular branch taps from mains shall be 45° entry fittings.
- C. Round Duct:
  - 1. Round Duct shall be spiral lock seam type, fabricated of galvanized steel strip with airtight four-ply lock seams Minimum 24 gage.
  - 2. Metal gauges shall be as listed in the SMACNA Standard for the pressure class indicated on the Drawings.
  - 3. Round duct shall be externally insulated.
- D. Round Fittings:
  - 1. Elbows for round ducts shall have a center line radius of 1.5 times the duct diameter.
  - 2. 45o and 90o elbows for ducts up to 8" diameter shall be die stamped two-piece with welded longitudinal seams.

3. Elbows for round ducts over 8" diameter shall be formed of segments with welded seams and following numbers of segments:
  - a. 90 degree elbow: 5 segments
  - b. 60 degree elbow: 3 segments
  - c. 45 degree elbow: 3 segments
  - d. 30 degree elbow: 2 segments
  - e. 22½ degree elbow: 2 segments
4. Tees, crosses and lateral cross fittings for round duct shall be of the conical type.
5. Reducers, increasers, offsets, wyes, crosses, divided flow fittings and similar fittings for round duct shall be one-piece construction with welded seams.
6. Metal gauges for fittings for round duct shall be as listed in SMACNA Standard for the pressure class indicated on the Drawings.
7. Duct and fitting welds shall be painted after fabrication to prevent corrosion where zinc has been burned by welding.
8. No bull headed tees shall be used.
9. Pipe-to-pipe joints for round ducts up to 50" diameter shall be made with male sleeve couplings reinforced by rolled bead.
10. Pipe-to-fitting joints for round ducts up to 50" shall be made by slip-fit of projecting collar of fitting into the duct.
11. Slip-fit joints shall be fastened with sheet metal screws, place ½" from fitting or coupling head.
12. Joints shall be sealed with duct sealant installed as recommended by the manufacturer.
13. Duct reinforcing, size of reinforcing angles and spacing shall be as recommended by SMACNA.

### 2.3 PLENUMS AND APPARATUS CASINGS

- A. Plenums shall be fabricated of same material as duct connecting to plenum and shall be two metal gauges heavier than gauge of largest duct connecting to plenum. Plenums used for connecting to exterior louvers shall have all seams welded watertight at the floor and 6 inches up the wall. In addition, plenums used for connection to exterior intake louvers shall have the floors sloped to a drain pipe connection and the drain piped to the nearest floor drain.
- B. Apparatus Casings shall be fabricated of not less than 18 gauge galvanized steel and shall be braced for rigidity. Bracing shall consist of not less than 2" x 2" x ¼ galvanized structural steel angles, spaced not more than 3'-0" on center. Main entry doors shall be provided for access to all apparatus and shall be fabricated of two thicknesses of not less than 22 gauge galvanized steel with 1" thick rigid glass filler. Provide 2" x 2" x ¼" galvanized welded, angle frames, hinges, airtight gaskets and two Young Regulator Co., No. 1335 or 1340 latches.

## 2.4 GAS FLUE/VENT

- A. General: Provide double wall gas vents, UL listed for Type B, consisting of double wall metal construction pipe sections and fittings and accessories required for complete installations.
- B. Material: Construct inner pipe of sheet aluminum, and outer pipe of galvanized sheet steel, both of the following minimum thickness:

| SIZE                  | INNER PIPE | OUTER PIPE |
|-----------------------|------------|------------|
| Round Sizes up to 6"  | 0.012"     | 28 ga.     |
| Round Sizes 7" to 18" | 0.014"     | 28 ga      |

- C. Accessories: Provide manufacturer's standard accessory items as required, for complete installation.
- D. Manufacturer: Subject to compliance with requirements, provide Type B double wall gas vents of one of the following: Hart & Cooley Manufacturing Co., Metalbestos Systems, or Metal-Fab, Inc.

## 2.5 DUCTWORK SUPPORT MATERIALS

- A. Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.

## 2.6 DUCT ACCESSORIES

- A. Transverse Duct Joints: May be made with the Ductmate Systems or an Engineer approved equivalent. The Ductmate Systems are to be used in accordance with the Ductmate factory installation and assembly instructions, (1-800-245-3188).
  - 1. Ductmate 440 or a Butyl Rubber Gasket which meets Mil-C 18969B, Type II Class B, T-C-1796 A, Type II Class B, and TTS-S-001657 must also pass UL-723. This material, in addition to the above, shall not contain vegetable oils, fish oils, or any other type vehicle that will support fungal and/or bacterial growth associated with dark, damp areas of ductwork. The recommended test procedure for bacterial and fungal growth is found in 21CFR 177, 1210 closures with sealing gaskets for food containers.
  - 2. Ductmate or W.D.C.I. proprietary duct connection systems are acceptable. Duct constructed using these systems shall refer to the manufacturer's guidelines for sheet gauge, intermediate reinforcement size and spacing, and joint reinforcements.
  - 3. Formed on flanges (T.D.C./T.D.F./T-25A/T-25B) are acceptable. Formed on flanges shall be constructed as SMACNA T-25 flanges, whose limits are defined on Page 1.36 1985 SMACNA Manual, First Edition. No other construction pertaining to formed on flanges will be accepted. Formed on flanges shall be accepted for use on ductwork 42" wide or less, 2" static positive pressure or less, and shall include the use of corners, bolts and cleat. (Over 42", the reinforcement/joint deflection criteria no longer conform to the UMC).

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve airtight (5% leakage for systems rated 3" and under; 1% for systems rated over 3") and noiseless (no objectionable noise) systems, capable of performing each indicated service. Install each run with minimum number of joints. Align ductwork accurately at connections, within 1/8" misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling. Support vertical ducts at every floor.
- B. Inserts: Install concrete inserts for support of ductwork in coordination with form work, as required to avoid delays in work.
- C. Field Fabrication: Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements.
- D. Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct usable space or block access for servicing building and its equipment. Install offsets, angles, and transitions as may be required to avoid interferences with other work, install streamlined easements around obstructions where necessary to pass obstructions through ducts. Maintain full capacity of ducts at offsets, angles, transitions and easements, except where Drawings indicated use of reducing or increasing transitions. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- E. Limit clearance to 1/2" where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1" clearance outside of insulation. Wherever possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.
- F. Where ducts pass through interior partitions and exterior walls, conceal the space between the construction opening and the duct or duct-plus-insulation with sheet metal flanges of the same gauge as the duct. Overlap the opening on all sides by at least 1 1/2".
- G. Coordinate duct installations with installation of accessories, equipment, controls and other associated work of the ductwork system.
- H. Each duct section shall be rigidly supported from structure. Attach hangers to structure with expansion plugs, concrete inserts, beam clamps or other approved means. Rubber-in-shear isolators shall be installed in hangers for ducts in equipment rooms, to prevent vibration transmission to the structure.
- I. Install as indicated on the Drawings duct mounted equipment as specified in other Sections.
- J. Duct sizes shown on Drawings are net inside dimensions. Increase duct sizes as required to allow for installation of duct liner, where specified.
- K. Application of Duct Sealant: All ducts to be properly sealed. Specified duct sealant to be pumped or painted into all joints and seams on all ductwork systems. Sealant shall be allowed to set 48 hours before any air pressure is applied to system.
- L. Electrical Equipment Spaces: Do not route ductwork through electrical equipment spaces and enclosures. Do not run ductwork above electrical panels.

### 3.2 EQUIPMENT CONNECTIONS

- A. General: Connect metal ductwork to equipment as indicated; provide flexible connection for each ductwork connection to equipment mounted on vibration isolators, and/or equipment containing rotating machinery.

### 3.3 ADJUSTING AND CLEANING

- A. Clean ductwork internally, unit by unit as it is installed, of dust and debris. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.
- B. Temporary Closure: At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until time connections are to be completed.
- C. Balancing: Refer to Section 23 0593, "Testing, Adjusting and Balancing for HVAC" for air distribution balancing of metal ductwork; not work of this section. Seal any leaks in ductwork that become apparent during the balancing process.

**END OF SECTION 23 3113**

SECTION 23 33 00  
AIR DUCT ACCESSORIES

**PART 1 GENERAL**

1.1 SUMMARY

- A. This Section includes the following:
1. Volume dampers.
  2. Fire dampers.
  3. Smoke dampers.
  4. Combination fire and smoke dampers.
  5. Turning vanes.
  6. Duct-mounting access doors.
  7. Flexible connectors.
  8. Flexible ducts.

1.2 SUBMITTALS

- A. Product Data: For the following:
1. Volume dampers.
  2. Fire dampers.
  3. Smoke dampers.
  4. Combination fire and smoke dampers.
  5. Turning vanes.
  6. Duct-mounting access doors.
  7. Flexible connectors.
  8. Flexible ducts.
- B. Shop Drawings:
1. Product Data: Submit manufacturer's technical product data and installation instructions for metal ductwork materials and products.

1.3 QUALITY ASSURANCE

- A. Codes and Standards
1. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
  2. Fire, Smoke, and Combination Dampers:
    - a. Constructed and tested in accordance with UL Safety Standard 555 and 555S, for 1 1/2 hour fire protection rating, with 165oF fusible link, and shall bear UL label.
  3. Ducts, plenums, apparatus casings, metal gauges, reinforcing, methods of supporting and hanging, and other sheet metal work as called for shall meet all functional criteria defined in the SMACNA "HVAC Duct Construction Standards Metal and Flexible" 2005, 3rd Edition. This shall be subsequently referred to as the SMACNA Manual. All ductwork must comply with all local, state and federal code requirements.



4. Comply with applicable requirements of NFPA 91.

## **PART 2 PRODUCTS**

### **2.1 VOLUME DAMPERS**

- A. Manual Volume Dampers: Fabricated of same material as ducts, two metal gauges heavier than duct and hemmed 1" all around, mounted on 3/8" square rod with saw slot position indicated. Pivot bearings, elocking position regulator, Young Regulator Co., Series 443.
  1. Where positioning regulator is not accessible, provide coupling and extension rod with regulator for ceiling wall or floor installation, as required. Young Series 301 and 315 for ceiling, Series 270-302 for walls.

### **2.2 FIRE DAMPERS**

- A. Manufacturers:
  1. Ruskin Manufacturing Company, Air Balance, Prefco or Pottorf.
  2. Design, specification and model numbers based on Ruskin Manufacturing Company.
- B. Materials
  1. Fire dampers shall be of the Class II dynamic rated curtain type, suitable for either vertical or horizontal installation, with 20 gauge steel channel frames, 24 gauge steel blades, and 18 gauges steel enclosure with duct collars. All parts galvanized mill finish.
  2. Fire dampers shall be Type D-IBD2 of the following style enclosures:
    - a. Style B or C; for square and rectangular ducts.
    - b. Style CR; for round ducts.
    - c. Style CO; for oval ducts.
- C. Provide thin-line type fire dampers in all transfer grilles and sidewall grilles installed in fire rated walls. Provide with maximum 2" frames, Type IB DT2.

### **2.3 SMOKE AND COMBINATION FIRE AND SMOKE DAMPERS**

- A. Manufacturers:
  1. Ruskin Manufacturing Company, Air Balance, Prefco. Pottorff, Leader Industries and United Enertec.
  2. Provide Belimo damper actuators for all fire/smoke and smoke dampers.
  3. Design, specification and model numbers based on Ruskin Manufacturing Company.
- B. Materials:
  1. Combination smoke and fire damper assemblies shall consist of a multi blade pivot type damper, suitable for either vertical or horizontal installation with 16 gauge steel channel frames, 16 gauge steel blades, stainless steel bearings, 1/2" steel shafts, 18 gauge steel enclosure with duct collars, operator mounting bracket, factory installed damper operator and linkage, and fusible link.
  2. Combination smoke and fire dampers shall be Type FSD 36 with Class II blade and jamb seals.

3. The damper actuator shall be electric, 120V, and shall be arranged for normally closed (NC) operation. The operator shall traverse the damper from fully open to fully closed and vice versa in no less than 30 seconds to allow a gradual decrease in duct pressure and airflow. The operator shall allow the smoke damper to be automatically reset upon clearance of alarm conditions or restoration of power.

## 2.4 TURNING VANES

### A. Manufacturers:

1. Aero Dyne; Ductmate; Anemostat; Barber Coleman; Duro Dyne; or Hart & Cooley.

### B. Provide single thickness streamline type, except provide turning vanes with trailing edge at elbows which change dimensions or at consecutive elbows.

### C. Provide manufactured turning vanes and vane runners, fabricated from the same material as the duct, and constructed in accordance with SMACNA "HVAC Duct Construction Standards". Tab spacing shall be SMACNA standard. Rail systems with non-standard tab spacings shall not be accepted. All tabs shall be used, do not skip tabs. Mounting rails shall have friction insert tabs which align the vanes automatically. Vanes shall be subjected to tensile loading and be capable of supporting 250 lbs. when fastened per the manufacturer's instructions.

## 2.5 DUCT-MOUNTING ACCESS DOORS

### A. General:

1. Shall be of same material as ducts in which they are installed, fabricated of two thicknesses of not less than 22 gauge, with 1" thick rigid glass fiber filler. Provide sheet metal frame, airtight gasket and two cam latches. Access doors and panels shall be 2 inches smaller than duct width and square for ducts 18" wide and larger, maximum size shall be 24" x 24" unless noted otherwise. For ducts less than 18" wide, access doors and panels shall be 2" smaller than duct width and 18" long. Pre-manufactured doors shall be hinged and shall be of adequate size to allow easy access to hardware which needs to be maintained.

## 2.6 FLEXIBLE DUCT CONNECTIONS

### A. Manufacturers:

1. Ventfabric, Inc., Ventglass, Duro Dyne, Ductmate or American/Elgin.

### B. General:

1. 30 ounce woven glass fiber, double neoprene coated, fire retardant, waterproof and airtight, suitable for temperatures to 200o F, UL approved.

## 2.7 FLEXIBLE DUCTS

### A. Manufacturers:

1. Flexible duct shall be by Thermaflex, Semco, Wiremold, or Engineer approved equal.

### B. General:

1. Acceptable in supply ductwork only where shown (not allowed in exposed occupied areas). Flexible duct shall include wire, core, insulation, and vapor barrier and the composite assembly shall meet requirements of NFPA-90A and UL181 and shall be UL listed for flame spread rating of not more than 25 and smoke developed rated of not more than 50.

### C. Minimum length of flexible duct shall be 3 feet.

- D. Maximum length of flexible duct shall be 8 feet.
- E. Flexible duct shall have a minimum R-value of 4.2.
- F. Flexible duct shall have a maximum vapor transmission rating of .1 perms.
- G. Flexible duct shall be rated for operating temperatures between -20 and 250 degrees.
- H. All flexible duct shall be connected to metal fittings with stainless steel bands equal to snaplock. The use of duct tape to secure the core is not acceptable.
- I. Flexible duct shall have an operating positive pressure rating of 16" wg for nominal sizes 4 thru 10 inch and 10" wg for nominal sizes 12 thru 16 inch, and a negative pressure rating of 2" wg for sizes 4 thru 16 inches. Duct shall be rated for a velocity of 6,000 feet per minute. Duct shall be equal to Thermaflex M-KE.

## 2.8 QUADRANT LOCKS

- A. Provide for each damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12".
- B. Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.

## PART 3 EXECUTION

### 3.1 APPLICATION AND INSTALLATION

- A. Install manual volume dampers in all supply, return and exhaust duct systems as required for controlling air volumes to trunk ducts, branch ducts, outlets and inlets. Contractor shall install a complete system of dampers as required for balancing air systems.
- B. Coordinate duct installations with installation of accessories, equipment, controls and other associated work of the ductwork system.
- C. Install access panels for inspection and servicing of duct mounted equipment; reheat coils, sound attenuators, and smoke and fire dampers.
- D. Install flexible connections in ducts at connections to plenums, apparatus casings, fan housings, roof top units, air handling units, exhaust fans and other equipment which could transmit vibrations to the duct systems. Crimp into duct flanges for attachment to duct and equipment. Make airtight joint. Provide adequate joint flexibility to allow for thermal axial, transverse, and torsional movement, and also capable of absorbing vibration of connected equipment.
- E. Install turning vanes in all square or rectangular 90° elbows in supply, return, and exhaust air systems.
- F. Installation of Flexible Ducts: Flexible Ducts are to be installed only where indicated on Drawings.
  - 1. Maximum length of flexible duct is 8'-0" OAL.
  - 2. Minimum length of flexible duct is 3'-0" OAL.
  - 3. Square to round transition gages to comply with SMACNA rectangular duct (minimum 24 ga.).
  - 4. Flexible duct must meet UL 181 and be installed per SMACNA using a clamp for securing duct to collar and a supplemental clamp for securing the insulation and vapor barrier.
  - 5. Support flexible ductwork with minimum 2" wide sheet metal bands, secured to structure with ductwork support materials. Maximum spacing shall be 4 feet on center.

6. The flexible duct shall be installed with a minimum centerline radius equal to 1.5 times the diameter of the duct.
  7. When connecting flexible duct to diffusers, the duct shall be installed with a minimum of 6" straight flex at the diffuser.
- G. Installation of Fire Dampers:
1. Install fire dampers in all locations where ducts penetrate fire walls and floors, as indicated on the Drawings.
  2. Install dampers in accordance with manufacturer's recommendations, utilizing steel sleeves, angles, and practices as required to provide an installation equivalent to that utilized by the manufacturer when the dampers are UL tested.
  3. At each damper, install access panel arranged for servicing fusible link.
  4. Contractor shall demonstrate, in presence of Owner's Representative, the operation of each fire damper. Fusible link shall be disconnected and damper shall be allowed to close. If no binding or sticking is evident, damper shall be set in the open position and fusible link reinstalled.
- H. Installation of Smoke or Combination Fire and Smoke Dampers:
1. Install smoke or combination smoke and fire dampers in locations where ducts penetrate smoke walls, as indicated on the Drawings.
  2. Install dampers in accordance with manufacturer's recommendations, utilizing steel sleeves, angles, and practices as required to provide an installation equivalent to that utilized by the manufacturer when the dampers were UL tested.
  3. At each damper, install access panel arranged for servicing fusible link.
  4. Contractor shall demonstrate, in presence of Owner's Representative, the operation of each combination smoke and fire dampers. Fusible link shall be disconnected and damper shall be allowed to close. If no binding or sticking is evident, damper shall be set in the open position and fusible link reinstalled.
  5. Final electrical connections to the damper operator shall be by the Electrical Fire Alarm Contractor.
  6. Smoke dampers shall be controlled and reset by the fire alarm system.

**END OF SECTION 23 3300**

SECTION 23 37 13  
DIFFUSERS, REGISTERS, AND GRILLES

**PART 1 GENERAL**

1.1 SUMMARY

- A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.
  - 1. Provide materials, devices, labor and supervision necessary for the installation of diffusers, registers and grilles
  - 2. Provide diffusers, registers and grilles as per schedule on Drawings.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data for diffusers, registers and grilles including the following:
  - 1. Schedule of diffusers, registers and grilles indicating drawing designation, room location, number furnished, model number, size and accessories furnished.
  - 2. Data sheet for each type of grille, register and diffuser and accessory furnished; indicating construction, finish and mounting details.
  - 3. Performance data for each type of grille, register and diffuser furnished, including aspiration ability, temperature and velocity traverses, throw and drop, and noise criteria ratings. Indicate selections on data.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawing for each type of grille, register and diffuser, indicating materials and methods of assembly of components.

1.3 QUALITY ASSURANCE

- A. Codes and Standards:
  - 1. ARI Compliance: Test and rate diffusers, registers and grilles in accordance with ARI 650 "Standard for Air Outlets and Inlets".
  - 2. ASHRAE Compliance: Test and rate diffusers, registers and grilles in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets".
  - 3. NFPA Compliance: Install diffusers, registers and grilles in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

**PART 2 PRODUCTS**

2.1 MANUFACTURERS

- A. Products by Titus, Krueger, Carnes, Metal-aire, Nailor, Price, or Engineer approved equivalent.

2.2 GRILLES AND REGISTERS

- A. General: Except as otherwise indicated, provide manufacturer's standard ceiling and wall registers and grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation. Provide O.B. volume damper for each supply grille and register, unless noted otherwise.

- B. Performance: Provide registers and grilles that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.
- C. Wall and Ceiling Compatibility: Provide registers and grilles with border styles that are compatible with adjacent wall and ceiling systems, and that are specifically manufactured to fit into wall and ceiling construction with accurate fit and adequate support. Refer to general construction drawings and specifications for types of wall and ceiling construction which will contain each type of register and grille.
- D. Types: Provide registers and grilles of type, capacity and with accessories and finishes as listed on register and grille schedule.

### 2.3 EGG CRATE GRILLE

- A. Furnish Eggcrate Grille with Aluminum Grid and Aluminum Border. Return grilles shall be the sizes and mounting types as shown on the plans and outlet schedule. Return grilles shall provide a free area of at least 90%. Outer borders shall be constructed of heavy extruded aluminum with a thickness of 0.040-0.050 inch and shall have countersunk screw holes for a neat appearance. Border width shall be 1¼ inches on all sides and shall be interlocked at the four corners and mechanically staked to form a rigid frame.
- B. Provide opposed-blade volume damper where indicated. OBD shall be constructed of heavy gauge aluminum. Damper must be operable from the face of the grille.
- C. The finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes. The pencil hardness shall be HB to H. The paint shall pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering or deterioration of film. The paint must pass a 250-hour ASTM D870 Water Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50-inch pound force applied.

### 2.4 CEILING SIDEWALL EXHAUST/RETURN

- A. Aluminum return grilles shall be equal to Titus Series Model 4F. The fixed deflection blades shall be available parallel to the short dimension of the grille. Construction shall be of extruded aluminum with a 1¼-inch wide border on all sides and shall be interlocked at the four corners and mechanically staked to form a rigid frame. Minimum border thickness shall be 0.040 to 0.050 inch. Screw holes shall be countersunk for a neat appearance.
- B. Blades shall be contoured to a specifically designed and tested cross-section to meet published performance data. Blades shall be firmly held in place by mullions from behind the grille and fixed in place by crimping or welding. Blade shall have a fixed deflection angle as noted on the schedule.
- C. Opposed-blade volume damper shall be constructed of heavy gauge aluminum. Damper must be operable from the face of the grille.
- D. The finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering or deterioration of film. The paint must pass a 250-hour ASTM D870 Water Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50-inch pound force applied.
- E. The manufacturer shall provide published performance data for the grille. The grille shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.

## 2.5 DOUBLE DEFLECTION SUPPLY

- A. Aluminum supply grilles shall be for the sizes and mounting types as shown on the plans and schedules. The deflection blades shall be available parallel to the long dimension of the grille. All supply grilles shall be constructed with a 1¼-inch wide heavy aluminum border having a minimum thickness of 0.040-0.050 inch. Outer borders shall be assembled and interlocked at the four corners and mechanically staked to form a rigid frame. Screw holes shall be countersunk for a neat appearance.
- B. Blades shall be constructed of heavy-duty aluminum and shall be contoured to a specifically designed airfoil cross-section to meet published performance data. Hollow blades are not acceptable. Blades must be solid. Blades shall be spaced ¾-inch apart. Blades shall extend completely through the side frame on each side to ensure stability throughout the complete cfm operating range of the grille. Blades shall be individually adjustable without loosening or rattling and shall be securely held in place with tension wire.
- C. Opposed-blade volume damper shall be constructed of heavy gauge steel or aluminum. Damper must be operable from the face of the grille.
- D. The finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering or deterioration of film. The paint must pass a 250-hour ASTM D870 Water Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50-inch pound force applied.
- E. The manufacturer shall provide published performance data for the grille. The grille shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.

## 2.6 ALUMINUM RETURN GRILLES

- A. Aluminum return grilles shall be of the sizes and mounting types shown on the plans and outlet schedule. The fixed deflection blades shall be available parallel to the long or short dimension of the grille. Construction shall be of extruded aluminum with a 1¼-inch wide border on all sides. Minimum border thickness shall be 0.040-0.050 inch. Sizes 24 x 24 inches and smaller shall be constructed using a roll-formed frame.
- B. Corners shall be welded with full penetration resistance welds. Sizes larger than 24 x 24 inches shall be constructed by using heavy aluminum extrusions and shall be interlocked at the four corners and mechanically staked to form a rigid frame. Screw holes shall be counter-sunk for a neat appearance.
- C. Deflection blades shall be contoured to a specifically designed and tested cross-section to meet published test performance data. Blades shall be firmly held in place by mullions from behind the grille and fixed in place by crimping or welding. Blade deflection angle shall be available at 0°.
- D. Opposed blade volume damper shall be constructed of heavy gauge steel or aluminum. Damper must be operable from the face of the grille.
- E. The finish shall be an anodic acrylic paint, baked at 315° F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering or deterioration of film. The paint must pass a 250-hour ASTM D870 Water Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50-inch pound force applied.
- F. The manufacturer shall provide published performance data for the grille. The grille shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- A. General: Install diffusers, registers and grilles in accordance with manufacturer's written instructions and in accordance with recognized industry practices to ensure that products serve intended functions.
- B. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work.
- C. Install wall mounted grilles and registers plumb and level and flush to surface. Locations may be altered slightly, as acceptable to the Architect/Engineer so as to fit portions of the structure.
- D. In grid panel type ceilings, lay-in metal pan, acoustical, etc., diffusers, registers and grilles shall be located as shown on the reflected ceiling plan or as directed by the Architect/Engineer typically to minimize cutting of ceiling panels.
- E. Coordinate location of ceiling diffusers and registers with Architect's reflected ceiling plan.
- F. Provide transitions as required for connections to ductwork, including square to round.
- G. Coordinate wall grilles and registers with thin-line type fire dampers in fire rated walls.
- H. Install diffusers, registers, and grilles level and plumb.
- I. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

### **3.2 ADJUSTING**

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

**END OF SECTION 23 3713**



SECTION 23 74 13  
PACKAGED, OUTDOOR, CENTRAL-STATION AIR-HANDLING UNITS

**PART 1 GENERAL**

1.1 SUMMARY

- A. The extent of packaged rooftop air-conditioning unit work is shown on Drawings and in schedules, and by requirements of this Section, and is hereby defined to include, but not by way of limitation, natural gas heat exchangers, refrigerant coils, condenser fans, filter units, supply fans, exhaust fans, compressors, and control systems.

1.2 CODES AND STANDARDS

- A. Installer: A firm with at least 3 years of successful installation experience on projects with packaged rooftop air-conditioning units.
- B. NFPA Compliance: Comply with applicable provisions of NFPA Stds. 70 and 90A, pertaining to construction and installation of packaged rooftop air-conditioning units.
- C. Flame-Smoke Ratings: Except as otherwise indicated, provide packaged rooftop air-conditioning unit thermal insulation with flame-spread rating of 25 or less, fuel-contributed of 50 or less, and smoke-developed rating of 50 or less.
- D. AMCA Standards: Comply with Air Movement and Control Association standards as applicable to testing and rating fans, and testing louvers, dampers and shutters.
- E. ARI Certification: Provide packaged rooftop air-conditioning units which comply with Air-Conditioning and Refrigeration Institute standards 210 and 270, and display ARI's certification symbol.
- F. UL Compliance: Provide packaged rooftop air-conditioning units which comply with applicable portions of UL 465, and with electrical components that bear UL labels.
- G. ANSI/ASHRAE Compliance: Comply with installation requirements of ANSI/ASHRAE 15, Safety Code for Mechanical Refrigeration.

1.3 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver packaged rooftop air-conditioning units with factory-installed shipping skids and lifting lugs; pack components in factory-fabricated protective framing.
- B. Handle packaged rooftop air-conditioning units carefully to avoid damage to components, enclosures and finish. Do not install damaged components; replace and return damaged components to air-conditioning unit manufacturer.
- C. Store packaged rooftop air-conditioning units in clean dry place and protect from weather and construction traffic.

1.4 SUBMITTALS

- A. Shop Drawings: Shop drawings shall indicate assembly, unit dimensions, weight loading, required clearances, construction details, and field connection details.
- B. Product Data: Product data shall indicate performance data relative to the information scheduled on the drawings. In addition, provide dimensions, weights, capacities, ratings, fan performance, motor electrical characteristics, and gages and finishes of materials.
- C. Provide fan curves with specified operating point clearly plotted.

- D. Submit sound power levels for both fan outlet and casing radiation at rated capacity.
- E. Submit product data of filter media, filter performance data, filter assembly, and filter frames.
- F. Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring clearly indicating factory installed and field installed wiring.
- G. Submit manufacturer's installation instructions.

## 1.5 ENVIRONMENTAL REQUIREMENTS

- A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

## PART 2 PRODUCTS

### 2.1 PACKAGED ROOFTOP AIR-CONDITIONING UNITS

- A. Manufacturers: Provide products produced by one of the following (for each type and capacity of equipment):
  - 1. Carrier Air-Conditioning Co.
  - 2. McQuay
  - 3. Trane Company
  - 4. York
- B. Provide factory-assembled, self-contained, packaged rooftop air-conditioning units of types, sizes, ratings and capacities indicated; consisting of, but not necessarily limited to, outdoor casings/cabinets, fans, fan motors and drives, condensers, compressors, heating section, filter units, dampers, electrical safety controls, environmental system controls and accessories required for a complete installation. Provide packaged rooftop air-conditioning units with the following functional and construction features indicated:
- C. Unit Casings:
  - 1. Provide outdoor type unit casings, double wall construction of zinc coated heavy gauge galvanized sheet steel, rigidly braced and reinforced with steel angle framework and of sufficient strength to prevent bending during rigging. Phosphatize and finish corrosive-resistant steel panels with epoxy-resin primer and baked enamel finish. Access doors or removable panels with quick fasteners screwdriver operated flush cam type. Doors shall provide access to all internal parts. Unit shall have 2" thick antimicrobial insulation with an R-value of 13. Design top panels for proper drainage. Seal top against air and water leakage with gasketing; top to be capable of properly supporting concentrated load of 250 lbs. Equip with drains on both sides of condenser section. Provide utility connection openings with curb enclosure and with single-point power cable connections. Unit lifting lugs shall accept chains or cable for riggings.
- D. Condensing Section
  - 1. Provide digital scroll primary compressor, 3600 rpm maximum, resiliently mounted with positive lubrication, crankcase heater, high and low pressure safety controls, motor overload protection, suction and discharge service valves and gage ports, and filter drier.
  - 2. Provide five-minute timed off circuit to delay compressor start.
  - 3. Outdoor thermostat to energize compressor above 35 degrees F ambient.
  - 4. Condenser coils shall be fabricated from seamless copper tubing mechanically bonded to aluminum fins. Each condenser coil shall be factory leak tested at 225 psig under water.

5. Condenser fans shall be direct drive, statically and dynamically balanced, propeller type designed for vertical air discharge, resiliently mounted, with fan guard, motor overload protection, and wired to operate with compressors. Fan blades shall be constructed of steel or cast aluminum.
- E. Cooling Coil Section
1. Evaporator coils shall be fabricated from seamless copper tubing mechanically bonded to aluminum fins. Coils shall be factory leak tested at 225 psig under water.
  2. A primary drain pan shall be provided with the cooling coil and extend beyond the leaving side of the coil and underneath the cooling coil connections. The drain pan shall be connected to a threaded drain connection extended through the unit base.
- F. Refrigeration Controls
1. Each compressor circuit shall include a liquid line solenoid valve, oil pressure switch, high-pressure switch, low-pressure switch, compressor control circuit switch and pump down switch. Each refrigeration circuit shall have at least one condenser fan controlled from an ambient thermostat for positive head pressure control. An adjustable 0 to 8 minute timer lockout shall be provided on each compressor to prevent short cycling on safety control or power interruption.
- G. Gas-Fired Heating Section:
1. Heat Exchanger: Corrosion resistant steel.
  2. Gas Burner: Atmospheric type burner with adjustable combustion air supply, pressure regulator, gas valve, manual shut-off, intermittent spark or glow coil ignition, flame sensing device, and automatic 100 percent shut-off pilot, modulating heating capacity.
  3. Gas Burner Safety Controls: Energize ignition, limit time for establishment of flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, energize blower motor, and after air flow proven and slight delay, allow gas valve to open.
  4. High Limit Control: Temperature sensor with fixed stop at maximum permissible setting, de-energize burner on excessive bonnet temperature and energize burner when temperature drops to a lower safe value.
  5. Supply Fan Control: Temperature sensor sensing bonnet temperatures and independent of burner controls, with provisions for continuous fan operation.
- H. Fans: Supply and Exhaust
1. Type: Forward curved with discharge dampers.
  2. Bearings: Self-aligning, grease lubricated, ball or roller type with lubrication fittings extended to exterior of casing, subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  3. Internal Mounting: Fan and motor on welded steel base with motor on slide rails, access through removable access panels or hinged access doors. Mount base on open spring vibration isolators.
  4. Belt Guard: Fabricate to SMACNA Low Pressure Duct Construction Standards.
- I. Filter Section:
1. Flat arrangement with 2 inch deep disposable panel filters. All filters shall be Class I.
  2. Filter gauges: [[3 ½] inch ([90] mm) diameter diaphragm actuated dial in metal case][One piece molded plastic inclined manometer] with static pressure tips.
  3. Furnish one extra set of filters per unit.

J. Mixed Air Section

1. Dampers: Provide remote controlled outside, exhaust and return air dampers with damper operator and remote rheostat for adjusting outside air quantity.
2. Gaskets: Provide tight fitting dampers with edge gaskets. Maximum leakage shall be 5 percent at 2 inches pressure differential.

K. Heat Recovery Wheel Section

1. Slide out, self-cleaning total energy wheel.
2. A rotating cylinder in an insulated cassette frame complete with seals, drive motor, and drive belt. Coated with silica gel desiccant permanently bonded to the frame Coated segments are washable.

L. Lights

1. Provide marine lights in accessible sections with wire guards, factory wired to weatherproof switch and GFI weatherproof duplex outlet mounted on casing exterior.

M. Drain Pans

1. Galvanized steel with welded corners, cross-broken and pitched to connection, under fan section, heating coil section, cooling coil section, mixing section, humidifier section, and plenum section.

N. Electrical

1. Each unit shall be wired and tested at the factory before shipment. Wiring shall comply with NEC requirements and shall conform with all applicable UL Standards. Each unit shall have a 24 vac control circuit transformer, system service switch, and control circuit fuse. Main control panel shall be of weatherproof construction. Provide starter, main disconnect switch and auxiliary contacts.

O. Temperature Controls

1. For other controls to be factory installed with units, system control requirements and sequence of operation, see 23 0900, "Instrumentation and Control for HVAC." Provide controls compatible with other system controls where interfacing is required.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Installer shall examine areas and conditions under which packaged rooftop air-conditioning units are to be installed, and notify Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

### **3.2 INSTALLATION OF PACKAGED ROOFTOP AIR-CONDITIONING UNITS**

- A. Install packaged rooftop air-conditioning units where shown in accordance with equipment manufacturer's written instructions, and recognized industry practices, to ensure that units comply with requirements and serve intended purposes.
- B. Coordinate with other work, including ductwork, roof decking, vibration isolation, piping and electrical work, as necessary to interface installation of packaged rooftop air-conditioning units with other work.
- C. Temporary Closure: Upon completion of installation, provide protective covering on packaged rooftop air-conditioning unit ductwork connection openings to prevent entrance of dust and debris into equipment.

- D. Install vibration isolators to properly isolate the unit vibration from the structure.
- E. Extend main cooling coil condensate drains through 4" deep (min.) traps, to nearest roof drain or as shown on Drawings.
- F. Provide temporary filters for packaged rooftop air-conditioning units for use during construction period. Install new filters at completion of rooftop system work, prior to testing, adjusting, and balancing work.
- G. Duct Connections: Provide ductwork, accessories, and flexible connections as indicated.
- H. Sound Attenuation: Fill voids (not in contact with airstream) between unit and building roof with batt insulation.

### 3.3 GROUNDING

- A. Provide positive equipment ground for packaged rooftop air-conditioning unit components.

### 3.4 TESTING

- A. Upon completion of packaged rooftop air-conditioning units and connection to completed air distribution system, start-up and test equipment in accordance with ARI Standards; operate unit to demonstrate capability and compliance with requirements. Where possible, field-correct malfunctioning units, then retest to demonstrate compliance.

### 3.5 MANUFACTURER'S START-UP

- A. Manufacturer shall furnish a factory trained service engineer without additional charge to start the unit(s).

### 3.6 WARRANTY

- A. Provide a full parts warranty for one year from start-up or 18 months from shipment, whichever occurs first.
- B. Provide five-year warranty for compressors.
- C. Provide five-year limited warranty for heat exchanger.

**END OF SECTION 23 7413**

SECTION 23 81 13  
PACKAGED TERMINAL HEAT PUMPS

**PART 1 GENERAL**

1.1 SUMMARY

- A. Provide material, equipment, labor, and supervision as necessary for complete installation of heat pumps, devices, controls, filters, and air conditioning.

1.2 SUBMITTALS

- A. Submit manufacturer's product, performance and installation data.

1.3 QUALITY ASSURANCE

- A. Standards and Codes
- B. Heat pumps shall be in accordance with N.E.C., NEMA, C.S.A, ARI, and be UL listed.

**PART 2 PRODUCTS**

2.1 MANUFACTURERS

- A. Heat pumps shall be by LG or engineer approved equivalent.

2.2 MATERIALS AND COMPONENTS

- A. General: Provide the packaged terminal heat pump with the manufacturer's standard materials and components, complying with the manufacturer's published product information, designed and constructed by the manufacturer for applications indicated, and as herein specified.
- B. Unit Casings: The unit casing shall be a single piece assembly with a removable front panel to allow service access to the chassis. The cabinet shall be constructed from reinforced 18 gauge steel. The entire cabinet, interior and exterior, shall be painted for corrosion protection. Painting shall consist of a primer coat and an electrostatically applied finish coat of baked on enamel paint. The front panel, top, and sides of the cabinet shall be insulated with 1/4" matt faced fiberglass thermal and acoustic insulation.
- C. Die Formed Glides: Provide with the unit a factory installed glide to allow easy assertion and removal of the entire chassis. The cabinet shall be constructed so that the gasketing material supplied with the chassis shall form a weathertight seal between the cabinet and chassis.
- D. Discharge Air Grille: Provide the unit with a discharge air grille constructed of stamped steel with four way adjustment capability. The control panel shall be a hinged door incorporated as an integral part of the grille assembly. The control panel door shall also protect the unit control from dust and wear.
- E. Controls: Provide with the packaged terminal heat pump a control panel which will provide the following modes of comfort, heat/low cool/high cool/vent (motorized)/off/on.
- F. Electrical: All wiring internal to the unit shall be done in accordance with the National Electric Code. Each unit shall be wired and tested at the factory before shipment. All necessary controls shall be factory installed and pre wired.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- A. Install the packaged split terminal heat pump flush with the ceiling.
- B. The room enclosure and panels to the packaged terminal heat pump shall be covered to protect them from damage during construction. The installing contractor shall be responsible for the protection of exposed parts until acceptance by the Owner. Damaged parts shall be replaced at no additional cost to the Owner.

### **3.2 FIELD QUALITY CONTROL**

- A. Upon completion of installation of the packaged terminal heat pumps, start up and test equipment and operate unit to demonstrate capability and compliance with requirements, where possible, field correct malfunctioning unit, then retest to demonstrate compliance

**END OF SECTION 23 8113**

SECTION 23 82 39  
UNIT HEATERS

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Provide materials, equipment, labor, and supervision necessary to install and test complete system of hot water unit heaters as required by the Drawings and this Section.

1.2 QUALIFICATIONS

- A. Acceptable manufacturers are Trane, Modine, Dunham Bush, American Air Filter Company, Airtherm, Sigma, Sterling and Zehnder Rittling.

1.3 SUBMITTALS

- A. Submit performance and product data.

**PART 2 PRODUCTS**

2.1 CABINET UNIT HEATERS

- A. Units shall have capacities and ratings and shall be of arrangement as scheduled on Drawings.
- B. Units shall be furnished complete with coils, enclosures, fans, and motors, as required to make complete functioning units.
- C. Units to be installed in finished areas to be furnished with bonderized, phosphatized, flow-coated baked-on primer with spray applied baked-on enamels in color as selected by Architect/Engineer.
- D. Coil shall be copper with aluminum fins mechanically bonded to copper tube surface. Maximum working pressure of 150 psig and test pressure of 225 psig.
- E. Motors shall be of the permanent split capacitor type with totally enclosed, Class 'B' insulation, built in overload protection, and prewired to terminal strip in factory mounted junction box.
- F. Controls except the coil control valves and thermostat shall be completely self-contained and factory mounted and tested. Controls shall be as follows:
  - 1. Manually operated 3-speed fan motor switch.
  - 2. Piping connections shall be on the side of the unit as indicated on the Drawings.
  - 3. Electrical connections shall be on the end of the unit opposite the piping connections.
  - 4. Filters supplied shall be 1" throw-away type.
  - 5. Hot water cabinet unit heaters shall be selected for water temperature scheduled. Heating elements shall be suitable for forced circulation hot water and tight closing throttling balancing fitting, with 1-1/4 in. air chamber to top of cabinet or at least 18 in. long, with accessible pet cock at high point to ensure complete venting. Where possible, heating elements must be self-venting and must be arranged to drain completely.



## 2.2 UNIT HEATERS

- A. Provide unit heater manufacturer's standard materials and components as indicated by published product information, designed and constructed as recommended by the manufacturer, and as required for a complete installation.
- B. Heating Coils:
  - 1. Heating Capacity: Size element for the indicated fan speed, cfm, entering air temperatures, and heating load (Btuh).
- C. Air Deflectors: Provide manufacturer's standard 4-way finned louver air deflectors.
- D. Motors:
  - 1. General: Provide totally enclosed shaded pole or permanent split capacitor motors, Class B insulation, resiliently mounted, tap wound with build-in thermal overload protection, sleeve bearings or permanently lubricated ball bearings.
- E. Fans:
  - 1. General: Provide aluminum propeller fans, balanced statically and dynamically, of the indicated capacity. Provide fans suitable for standard or sparkproof application.
- F. Provide self-contained thermostat mounted near the return air to the unit unless specifically noted otherwise in the DDC temperature controls section.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install systems as indicated on Plans and in the Specifications and as recommended by the manufacturer.
- B. Install unit heaters as indicated, level. Anchor cabinet unit heaters to substrate. Use metallic concrete anchors.
- C. Test and clean the unit heaters.

**END OF SECTION 23 8239**

SECTION 26 05 00  
COMMON WORK RESULTS FOR ELECTRICAL

**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. Electrical equipment coordination and installation.
  - 2. Sleeves for raceways and cables.
  - 3. Sleeve seals.
  - 4. Grout.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 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. 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.

**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.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral water stop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
  - 1. Minimum Metal Thickness:
    - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
    - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

## 2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
  - 1. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
  - 2. Pressure Plates: Carbon steel. Include two for each sealing element.
  - 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## 2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

# PART 3 EXECUTION

## 3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Comply with applicable provisions of Occupational Safety and Health Act (OSHA), NFPA Standards and Pamphlets, NEIS Standards, and common workplace practice.
- 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.

## 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 (50 mm) above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
  - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

- I. 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."
- J. 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."
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

### 3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### 3.4 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 26 05 00**

SECTION 26 05 05  
SELECTIVE DEMOLITION FOR ELECTRICAL

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Electrical demolition.

1.2 RELATED REQUIREMENTS

- A. Section 01 70 00 - Execution and Closeout Requirements: Additional requirements for alterations work.

**PART 2 PRODUCTS**

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment for patching and extending work: As specified in individual sections.

**PART 3 EXECUTION**

3.1 EXAMINATION

- A. Verify that abandoned wiring and equipment serve only abandoned facilities.
- B. Demolition drawings are based on casual field observation and existing record documents.
- C. Report discrepancies to Architect/Engineer before disturbing existing installation.
- D. Beginning of demolition means installer accepts existing conditions.

3.2 PREPARATION

- A. Disconnect electrical systems in walls, floors, and ceilings to be removed.
- B. Coordinate utility service outages with utility company.
- C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- D. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
  - 1. Obtain permission from Owner at least 24 hours before partially or completely disabling system.
  - 2. Make temporary connections to maintain service in areas adjacent to work area.

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Perform work for removal and disposal of equipment and materials containing toxic substances regulated under the Federal Toxic Substances Control Act (TSCA) in accordance with applicable federal, state, and local regulations. Applicable equipment and materials include, but are not limited to:
  - 1. PCB-containing electrical equipment, including transformers, capacitors, and switches.

2. PCB- and DEHP-containing lighting ballasts.
  3. Mercury-containing lamps and tubes, including fluorescent lamps, high intensity discharge (HID), arc lamps, ultra-violet, high-pressure sodium, mercury vapor, ignitron tubes, neon, and incandescent.
- B. Remove, relocate, and extend existing installations to accommodate new construction.
  - C. Remove abandoned wiring to source of supply.
  - D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
  - E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.
  - F. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
  - G. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
  - H. Repair adjacent construction and finishes damaged during demolition and extension work.
  - I. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.
  - J. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

#### 3.4 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment that remain or that are to be reused.
- B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

**END OF SECTION**

SECTION 26 05 19  
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Single conductor building wire.
- B. Wiring connectors.
- C. Electrical tape.
- D. Wire pulling lubricant.
- E. Cable ties.

1.2 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.

1.3 REFERENCE STANDARDS

- A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013 (Reapproved 2018).
- B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2023.
- C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010, with Editorial Revision (2020).
- D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2020).
- E. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2017.
- F. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- G. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy; 2021.
- H. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
- I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.
- K. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.
- L. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.
- M. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.
- N. UL 486D - Sealed Wire Connector Systems; Current Edition, Including All Revisions.

- O. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

##### A. Coordination:

1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
3. Notify Architect/Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

#### 1.5 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.
- B. Field Quality Control Test Reports.
- C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- D. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing for underground circuits.

#### 1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

#### 1.8 FIELD CONDITIONS

- A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F (-10 degrees C), unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect/Engineer and obtain direction before proceeding with work.

## PART 2 PRODUCTS

### 2.1 CONDUCTOR AND CABLE APPLICATIONS

- A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.



- B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
  - 1. Exceptions:
    - a. Use manufactured wiring systems for branch circuits where concealed above accessible ceilings for lighting.
      - 1) Exception: Provide single conductor building wire in raceway for circuit homerun from distribution box to panelboard.
- C. Nonmetallic-sheathed cable is not permitted.
- D. Underground feeder and branch-circuit cable is not permitted.
- E. Metal-clad cable is not permitted.

## 2.2 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
- D. Comply with NEMA WC 70.
- E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.
- F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.
- G. Conductors for Grounding and Bonding: Also comply with Section 26 05 26.
- H. Conductor Material:
  - 1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.
  - 2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
  - 3. Tinned Copper Conductors: Comply with ASTM B33.
- I. Minimum Conductor Size: 12 AWG.
- J. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- K. Conductor Color Coding:
  - 1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
  - 2. Color Coding Method: Integrally colored insulation.
    - a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
  - 3. Color Code:
    - a. 480Y/277 V, 3 Phase, 4 Wire System:
      - 1) Phase A: Brown.
      - 2) Phase B: Orange.
      - 3) Phase C: Yellow.

- 4) Neutral/Grounded: Gray.
- b. 208Y/120 V, 3 Phase, 4 Wire System:
  - 1) Phase A: Black.
  - 2) Phase B: Red.
  - 3) Phase C: Blue.
  - 4) Neutral/Grounded: White.
- c. Equipment Ground, All Systems: Green.

## 2.3 SINGLE CONDUCTOR BUILDING WIRE

- A. Manufacturers:
  - 1. Copper Building Wire:
    - a. General Cable Technologies Corporation: [www.generalcable.com/#sle](http://www.generalcable.com/#sle).
    - b. Nexans Energy USA
    - c. The Okonite Company
    - d. Prysmian Power Cables and Systems [[->](http://www.us.prysmian.com)]: [www.us.prysmian.com](http://www.us.prysmian.com)
    - e. Southwire Company: [www.southwire.com/#sle](http://www.southwire.com/#sle).
- B. Description: Single conductor insulated wire.
- C. Conductor Stranding:
  - 1. Feeders and Branch Circuits:
    - a. Size 10 AWG and Smaller: Solid.
    - b. Size 8 AWG and Larger: Stranded.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation:
  - 1. Copper Building Wire: Type THHN/THWN-2, except as indicated below.

## 2.4 WIRING CONNECTORS

- A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.
- B. Connectors for Grounding and Bonding: Comply with Section 26 05 26.
- C. Wiring Connectors for Splices and Taps:
  - 1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
  - 2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.
- D. Wiring Connectors for Terminations:
  - 1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
  - 2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.

3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
4. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
- E. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F (105 degrees C) for standard applications and 302 degrees F (150 degrees C) for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
- F. Mechanical Connectors: Provide bolted type or set-screw type.
- G. Compression Connectors: Provide circumferential type or hex type crimp configuration.
- H. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.

## 2.5 WIRING ACCESSORIES

- A. Electrical Tape:
  1. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil (0.18 mm); resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F (105 degrees C).
  2. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil (0.18 mm); resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F (-18 degrees C) and suitable for continuous temperature environment up to 221 degrees F (105 degrees C).
- B. Cable Ties: Material and tensile strength rating suitable for application.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that work likely to damage wire and cable has been completed.
- C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.
- D. Verify that field measurements are as indicated.
- E. Verify that conditions are satisfactory for installation prior to starting work.

### 3.2 PREPARATION

- A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

### 3.3 INSTALLATION

- A. Circuiting Requirements:
  1. Unless dimensioned, circuit routing indicated is diagrammatic.
  2. When circuit destination is indicated without specific routing, determine exact routing required.

3. Include circuit lengths required to install connected devices within 10 ft (3.0 m) of location indicated.
  4. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
  5. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
  6. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is permitted, under the following conditions:
    - a. Provide no more than six current-carrying conductors in a single raceway. Dedicated neutral conductors are considered current-carrying conductors.
    - b. Increase size of conductors as required to account for ampacity derating.
    - c. Size raceways, boxes, etc. to accommodate conductors.
  7. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.
- B. Install products in accordance with manufacturer's instructions.
- C. Perform work in accordance with NECA 1 (general workmanship).
- D. Installation in Raceway:
1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
  2. Pull all conductors and cables together into raceway at same time.
  3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
  4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.
- E. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.
- F. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.
- G. Terminate cables using suitable fittings.
- H. Install conductors with a minimum of 12 inches (300 mm) of slack at each outlet.
- I. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
- J. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.
- K. Make wiring connections using specified wiring connectors.
1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.

2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
  3. Do not remove conductor strands to facilitate insertion into connector.
  4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminants. Do not use wire brush on plated connector surfaces.
  5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
  6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- L. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
- M. Insulate ends of spare conductors using vinyl insulating electrical tape.
- N. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.
- O. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
- P. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

#### 3.4 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.
- D. Correct deficiencies and replace damaged or defective conductors and cables.

**END OF SECTION**

SECTION 26 05 26  
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Grounding and bonding requirements.
- B. Conductors for grounding and bonding.
- C. Connectors for grounding and bonding.
- D. Ground bars.
- E. Ground access wells.

1.2 RELATED REQUIREMENTS

- A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
- B. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.3 REFERENCE STANDARDS

- A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System; 2012.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- C. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Verify exact locations of underground metal water service pipe entrances to building.
  - 2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
  - 3. Notify Architect/Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- B. Sequencing:
  - 1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.5 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

## PART 2 PRODUCTS

### 2.1 GROUNDING AND BONDING REQUIREMENTS

- A. Do not use products for applications other than as permitted by NFPA 70 and product listing.
- B. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.
- C. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- D. Separately Derived System Grounding:
  - 1. Separately derived systems include, but are not limited to:
    - a. Transformers (except autotransformers such as buck-boost transformers).
  - 2. Provide grounding electrode conductor to connect derived system grounded conductor to nearest effectively grounded metal building frame. Unless otherwise indicated, make connection at neutral (grounded) bus in source enclosure.
  - 3. Provide bonding jumper to connect derived system grounded conductor to nearest metal building frame and nearest metal water piping in the area served by the derived system, where not already used as a grounding electrode for the derived system. Make connection at same location as grounding electrode conductor connection.
  - 4. Provide system bonding jumper to connect system grounded conductor to equipment ground bus. Make connection at same location as grounding electrode conductor connection. Do not make any other connections between neutral (grounded) conductors and ground on load side of separately derived system disconnect.
  - 5. Where the source and first disconnecting means are in separate enclosures, provide supply-side bonding jumper between source and first disconnecting means.
- E. Bonding and Equipment Grounding:
  - 1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
  - 2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
  - 3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
  - 4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
  - 5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.

6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
  7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
    - a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
  8. Provide bonding for interior metal air ducts.
  9. Provide bonding for metal building frame.
- F. Communications Systems Grounding and Bonding:
1. Provide intersystem bonding termination at service equipment or metering equipment enclosure and at disconnecting means for any additional buildings or structures in accordance with NFPA 70.
  2. Provide bonding jumper in raceway from intersystem bonding termination to each communications room or backboard and provide ground bar for termination.
    - a. Bonding Jumper Size: 6 AWG, unless otherwise indicated or required.
    - b. Raceway Size: 3/4 inch (21 mm) trade size unless otherwise indicated or required.
    - c. Ground Bar Size: 1/4 by 2 by 12 inches (6 by 50 by 300 mm) unless otherwise indicated or required.
    - d. Ground Bar Mounting Height: 18 inches (450 mm) above finished floor unless otherwise indicated.

## 2.2 GROUNDING AND BONDING COMPONENTS

- A. General Requirements:
1. Provide products listed, classified, and labeled as suitable for the purpose intended.
  2. Provide products listed and labeled as complying with UL 467 where applicable.
- B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 05 26:
1. Use insulated copper conductors unless otherwise indicated.
    - a. Exceptions:
      - 1) Use bare copper conductors where installed underground in direct contact with earth.
      - 2) Use bare copper conductors where directly encased in concrete (not in raceway).
- C. Connectors for Grounding and Bonding:
1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
  2. Unless otherwise indicated, use exothermic welded connections or compression connectors for underground, concealed and other inaccessible connections.
    - a. Exceptions:
      - 1) Use mechanical connectors for connections to electrodes at ground access wells.
  3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.



- a. Exceptions:
  - 1) Use exothermic welded connections for connections to metal building frame.
- D. Ground Bars:
  - 1. Description: Copper rectangular ground bars with mounting brackets and insulators.
  - 2. Size: 12X4 unless otherwise indicated or required.
  - 3. Holes for Connections: As indicated or as required for connections to be made.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that work likely to damage grounding and bonding system components has been completed.
- B. Verify that field measurements are as indicated.
- C. Verify that conditions are satisfactory for installation prior to starting work.

### **3.2 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Make grounding and bonding connections using specified connectors.
  - 1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
  - 2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
  - 3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
  - 4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
  - 5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- D. Identify grounding and bonding system components in accordance with Section 26 05 53.

### **3.3 FIELD QUALITY CONTROL**

- A. Inspect and test in accordance with NETA ATS except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.13.
- C. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.
- D. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.
- E. Submit detailed reports indicating inspection and testing results and corrective actions taken.

## **END OF SECTION**

SECTION 26 05 29  
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

1.2 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 05 50 00 - Metal Fabrications: Materials and requirements for fabricated metal supports.
- C. Section 26 05 33.13 - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.
- D. Section 26 05 36 - Cable Trays for Electrical Systems: Additional support and attachment requirements for cable tray.
- E. Section 26 05 33.16 - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.
- F. Section 26 51 00 - Interior Lighting: Additional support and attachment requirements for interior luminaires.

1.3 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2019.
- D. MFMA-4 - Metal Framing Standards Publication; 2004.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL 5B - Strut-Type Channel Raceways and Fittings; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
  - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
  - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.

4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
  5. Notify Architect/Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- B. Sequencing:
1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 30 00.

#### 1.5 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with applicable building code.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of four times the applied force.
- E. Installer Qualifications for Field-Welding: As specified in Section 05 50 00.
- F. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.
- G. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

#### 1.6 DELIVERY, STORAGE, AND HANDLING

### **PART 2 PRODUCTS**

#### 2.1 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
  2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
  3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of 2.5. Include consideration for vibration, equipment operation, and shock loads where applicable.
  4. Do not use products for applications other than as permitted by NFPA 70 and product listing.
  5. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
    - a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.

- b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
  - c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
  - d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.
  - 1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
  - 2. Conduit Clamps: Bolted type unless otherwise indicated.
- C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- D. Outlet Box Supports: Hangers, brackets, etc. suitable for the boxes to be supported.
- E. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
  - 1. Comply with MFMA-4.
  - 2. Channel (Strut) Used as Raceway (only where specifically indicated): Listed and labeled as complying with UL 5B.
  - 3. Minimum Channel Thickness: Steel sheet, 12 gage, 0.1046 inch (2.66 mm).
  - 4. Minimum Channel Dimensions: 1-5/8 inch (41 mm) width by 13/16 inch (21 mm) height.
- F. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
  - 1. Minimum Size, Unless Otherwise Indicated or Required:
    - a. Equipment Supports: 1/2 inch (13 mm) diameter.
    - b. Busway Supports: 1/2 inch (13 mm) diameter.
    - c. Single Conduit up to 1 inch (27 mm) trade size: 1/4 inch (6 mm) diameter.
    - d. Single Conduit larger than 1 inch (27 mm) trade size: 3/8 inch (10 mm) diameter.
    - e. Trapeze Support for Multiple Conduits: 3/8 inch (10 mm) diameter.
    - f. Outlet Boxes: 1/4 inch (6 mm) diameter.
    - g. Luminaires: 1/4 inch (6 mm) diameter.
- G. Non-Penetrating Rooftop Supports for Low-Slope Roofs: Steel pedestals with thermoplastic or rubber bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.
  - 1. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
  - 2. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
  - 3. Mounting Height: Provide minimum clearance of 6 inches (150 mm) under supported component to top of roofing.
- H. Anchors and Fasteners:
  - 1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.

2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
4. Hollow Masonry: Use toggle bolts.
5. Hollow Stud Walls: Use toggle bolts.
6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
7. Sheet Metal: Use sheet metal screws.
8. Wood: Use wood screws.
9. Plastic and lead anchors are not permitted.
10. Powder-actuated fasteners are not permitted.
11. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
  - a. Comply with MFMA-4.
  - b. Channel Material: Use galvanized steel.
  - c. Manufacturer: Same as manufacturer of metal channel (strut) framing system.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

### **3.2 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- D. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- E. Install support and attachment components for steel conduits in accordance with NECA 101
- F. Unless specifically indicated or approved by Architect/Engineer, do not provide support from suspended ceiling support system or ceiling grid.
- G. Unless specifically indicated or approved by Architect/Engineer, do not provide support from roof deck.
- H. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- I. Equipment Support and Attachment:
  1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
  2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.

3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
  4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 3 inch (80 mm) high concrete pad constructed in accordance with Section 03 30 00.
  5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- J. Conduit Support and Attachment: Also comply with Section 26 05 33.13.
- K. Box Support and Attachment: Also comply with Section 26 05 33.16.
- L. Interior Luminaire Support and Attachment: Also comply with Section 26 51 00.
- M. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
- N. Secure fasteners according to manufacturer's recommended torque settings.
- O. Remove temporary supports.
- P. Identify independent electrical component support wires above accessible ceilings (only where specifically indicated or permitted) with color distinguishable from ceiling support wires in accordance with NFPA 70.
- Q. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
1. To Wood: Fasten with lag screws or through bolts.
  2. To New Concrete: Bolt to concrete inserts.
  3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  4. To Existing Concrete: Expansion anchor fasteners.
  5. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
  6. To Light Steel: Sheet metal screws.
  7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet anchorage requirements.

### 3.3 FIELD QUALITY CONTROL

- A. Inspect support and attachment components for damage and defects.
- B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- C. Correct deficiencies and replace damaged or defective support and attachment components.

**END OF SECTION**

SECTION 26 05 33.13  
CONDUIT FOR ELECTRICAL SYSTEMS

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Galvanized steel rigid metal conduit (RMC).
- B. Flexible metal conduit (FMC).
- C. Liquidtight flexible metal conduit (LFMC).
- D. Electrical metallic tubing (EMT).
- E. Rigid polyvinyl chloride (PVC) conduit.
- F. Conduit fittings.
- G. Accessories.

1.2 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
  - 1. Includes additional requirements for fittings for grounding and bonding.
- C. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- D. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 31 23 16 - Excavation.
- F. Section 31 23 23 - Fill: Bedding and backfilling.

1.3 REFERENCE STANDARDS

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2020.
- B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S); 2020.
- C. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit; 2018.
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- E. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2020.
- F. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); 2017.
- G. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
- H. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; 2020.
- I. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; 2021.
- J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.
- L. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.

- M. UL 360 - Liquid-Tight Flexible Metal Conduit; Current Edition, Including All Revisions.
- N. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.
- O. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.
- P. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.
- Q. UL 1242 - Electrical Intermediate Metal Conduit-Steel; Current Edition, Including All Revisions.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

##### A. Coordination:

1. Coordinate minimum sizes of conduits with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
2. Coordinate the arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
3. Verify exact conduit termination locations required for boxes, enclosures, and equipment installed under other sections or by others.
4. Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
5. Notify Architect/Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

##### B. Sequencing:

1. Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction and splicing points.

#### 1.5 QUALITY ASSURANCE

##### A. Conform to requirements of NFPA 70.

##### B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

##### A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

## PART 2 PRODUCTS

### 2.1 CONDUIT APPLICATIONS

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.
- B. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.
- C. Underground:
  1. Under Slab on Grade: Use rigid PVC conduit.



2. Exterior, Direct-Buried: Use galvanized steel rigid metal conduit or rigid PVC conduit.
  3. Exterior, Embedded Within Concrete: Use galvanized steel rigid metal conduit.
  4. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from underground.
  5. Where steel conduit is installed in direct contact with earth where soil has a resistivity of less than 2000 ohm-centimeters or is characterized as severely corrosive based on soils report or local experience, use corrosion protection tape to provide supplementary corrosion protection or use PVC-coated galvanized steel rigid metal conduit.
  6. Where steel conduit emerges from concrete into soil, use corrosion protection tape to provide supplementary corrosion protection for a minimum of 4 inches (100 mm) on either side of where conduit emerges or use PVC-coated galvanized steel rigid metal conduit.
- D. Embedded Within Concrete:
1. Within Slab on Grade: Not permitted.
  2. Within Slab Above Ground: Not permitted.
- E. Concealed Within Masonry Walls: Use galvanized steel rigid metal conduit or electrical metallic tubing (EMT).
- F. Concealed Within Hollow Stud Walls: Use galvanized steel rigid metal conduit or electrical metallic tubing (EMT).
- G. Concealed Above Accessible Ceilings: Use electrical metallic tubing (EMT).
- H. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit.
- I. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit.
- J. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit.
1. Locations subject to physical damage include, but are not limited to:
    - a. Where exposed below 8 feet (2.4 m), except within electrical and communication rooms or closets.
- K. Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use galvanized steel rigid metal conduit.
- L. Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit.
1. Maximum Length: 6 feet (1.8 m).
- M. Connections to Vibrating Equipment:
1. Dry Locations: Use flexible metal conduit.
  2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit.
  3. Maximum Length: 6 feet (1.8 m) unless otherwise indicated.
  4. Vibrating equipment includes, but is not limited to:
    - a. Transformers.
    - b. Motors.
- N. Fished in Existing Walls, Where Necessary: Use flexible metal conduit.

## 2.2 CONDUIT REQUIREMENTS

- A. Existing Work: Where existing conduits are indicated to be reused, they may be reused only where they comply with specified requirements, are free from corrosion, and integrity is verified by pulling a mandrel through them.

- B. Fittings for Grounding and Bonding: Also comply with Section 26 05 26.
- C. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.
- D. Provide products listed, classified, and labeled as suitable for the purpose intended.
- E. Minimum Conduit Size, Unless Otherwise Indicated:
  - 1. Branch Circuits: 3/4 inch (21 mm) trade size.
  - 2. Branch Circuit Homeruns: 3/4 inch (21 mm) trade size.
- F. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

### 2.3 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.
- B. Fittings:
  - 1. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
  - 2. Material: Use steel or malleable iron.
  - 3. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

### 2.4 FLEXIBLE METAL CONDUIT (FMC)

- A. Description: NFPA 70, Type FMC standard wall steel flexible metal conduit listed and labeled as complying with UL 1 and listed for use in classified firestop systems to be used.
- B. Fittings:
  - 1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
  - 2. Material: Use steel or malleable iron.

### 2.5 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.
- B. Fittings:
  - 1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
  - 2. Material: Use steel or malleable iron.

### 2.6 ELECTRICAL METALLIC TUBING (EMT)

- A. Description: NFPA 70, Type EMT steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.
- B. Fittings:
  - 1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
  - 2. Material: Use steel.

3. Connectors and Couplings: Use compression (gland) type.
  - a. Do not use indenter type connectors and couplings.
  - b. Do not use set-screw type connectors and couplings.
4. Damp or Wet Locations (where permitted): Use fittings listed for use in wet locations.
5. Embedded Within Concrete (where permitted): Use fittings listed as concrete-tight. Fittings that require taping to be concrete-tight are not acceptable.

## 2.7 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

- A. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.
- B. Fittings:
  1. Manufacturer: Same as manufacturer of conduit to be connected.
  2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

## 2.8 ACCESSORIES

- A. Conduit Joint Compound: Corrosion-resistant, electrically conductive; suitable for use with the conduit to be installed.
- B. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.
- C. Pull Strings: Use nylon cord with average breaking strength of not less than 200 pound-force (890 N).
- D. Sealing Compound for Sealing Fittings: Listed for use with the particular fittings to be installed.
- E. Modular Seals for Conduit Penetrations: Rated for minimum of 40 psig; Suitable for the conduits to be installed.

# PART 3 EXECUTION

## 3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive conduits.
- C. Verify that conditions are satisfactory for installation prior to starting work.

## 3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.
- D. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.
- E. Conduit Routing:
  1. Unless dimensioned, conduit routing indicated is diagrammatic.

2. When conduit destination is indicated without specific routing, determine exact routing required.
  3. Conceal all conduits unless specifically indicated to be exposed.
  4. Conduits in the following areas may be exposed, unless otherwise indicated:
    - a. Electrical rooms.
    - b. Mechanical equipment rooms.
    - c. Within joists in areas with no ceiling.
  5. Unless otherwise approved, do not route conduits exposed:
    - a. Across floors.
    - b. Across roofs.
    - c. Across top of parapet walls.
    - d. Across building exterior surfaces.
  6. Conduits installed underground or embedded in concrete may be routed in the shortest possible manner unless otherwise indicated. Route all other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
  7. Arrange conduit to maintain adequate headroom, clearances, and access.
  8. Arrange conduit to provide no more than the equivalent of four 90 degree bends between pull points.
  9. Arrange conduit to provide no more than 150 feet (46 m) between pull points.
  10. Route conduits above water and drain piping where possible.
  11. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
  12. Maintain minimum clearance of 6 inches (150 mm) between conduits and piping for other systems.
  13. Maintain minimum clearance of 12 inches (300 mm) between conduits and hot surfaces. This includes, but is not limited to:
    - a. Heaters.
    - b. Hot water piping.
    - c. Flues.
  14. Group parallel conduits in the same area together on a common rack.
- F. Conduit Support:
1. Secure and support conduits in accordance with NFPA 70 and Section 26 05 29 using suitable supports and methods approved by the authority having jurisdiction.
  2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
  3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
  4. Use metal channel (strut) with accessory conduit clamps to support multiple parallel surface-mounted conduits.
  5. Use conduit clamp to support single conduit from beam clamp or threaded rod.

6. Use trapeze hangers assembled from threaded rods and metal channel (strut) with accessory conduit clamps to support multiple parallel suspended conduits.
  7. Use of wire for support of conduits is not permitted.
  8. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with the most stringent requirements.
- G. Connections and Terminations:
1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
  2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
  3. Use suitable adapters where required to transition from one type of conduit to another.
  4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
  5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
  6. Where spare conduits stub up through concrete floors and are not terminated in a box or enclosure, provide threaded couplings equipped with threaded plugs set flush with finished floor.
  7. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
  8. Secure joints and connections to provide maximum mechanical strength and electrical continuity.
- H. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
  2. Make penetrations perpendicular to surfaces unless otherwise indicated.
  3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
  4. Conceal bends for conduit risers emerging above ground.
  5. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
  6. Provide suitable modular seal where conduits penetrate exterior wall below grade.
  7. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
  8. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty. Include proposed locations of penetrations and methods for sealing with submittals.
  9. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
- I. Underground Installation:
1. Minimum Cover, Unless Otherwise Indicated or Required:
    - a. Underground, Exterior: 24 inches (610 mm).

- b. Under Slab on Grade: 12 inches (300 mm) to bottom of slab.
- 2. Provide underground warning tape in accordance with Section 26 05 53 along entire conduit length for service entrance where not concrete-encased.
- J. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
  - 1. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
  - 2. Where conduits are subject to earth movement by settlement or frost.
- K. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
  - 1. Where conduits pass from outdoors into conditioned interior spaces.
  - 2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
- L. Provide pull string in all empty conduits and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches (300 mm) at each end.
- M. Provide grounding and bonding in accordance with Section 26 05 26.
- N. Identify conduits in accordance with Section 26 05 53.

### 3.3 FIELD QUALITY CONTROL

- A. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- B. Correct deficiencies and replace damaged or defective conduits.

### 3.4 CLEANING

- A. Clean interior of conduits to remove moisture and foreign matter.

### 3.5 PROTECTION

- A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

**END OF SECTION**

SECTION 26 05 33.16  
BOXES FOR ELECTRICAL SYSTEMS

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Outlet and device boxes up to 100 cubic inches (1,650 cu cm), including those used as junction and pull boxes.
- B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches (1,650 cu cm).

1.2 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 08 31 00 - Access Doors and Panels: Panels for maintaining access to concealed boxes.
- C. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- D. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 26 27 26 - Wiring Devices:
  - 1. Wall plates.
  - 2. Additional requirements for locating boxes for wiring devices.
- F. Section 27 10 00 - Structured Cabling: Additional requirements for communications systems outlet boxes.

1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
- C. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
- D. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013 (Reaffirmed 2020).
- E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2018.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- H. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- I. UL 508A - UL Standard for Safety Industrial Control Panels; 2018.
- J. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.

## 1.4 ADMINISTRATIVE REQUIREMENTS

### A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
6. Coordinate the work with other trades to preserve insulation integrity.
7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
8. Notify Architect/Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

## 1.5 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

## **PART 2 PRODUCTS**

### 2.1 BOXES

#### A. General Requirements:

1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
3. Provide products listed, classified, and labeled as suitable for the purpose intended.
4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
5. Provide grounding terminals within boxes where equipment grounding conductors terminate.



- B. Outlet and Device Boxes Up to 100 cubic inches (1,650 cu cm), Including Those Used as Junction and Pull Boxes:
  - 1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
  - 2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
  - 3. Use suitable concrete type boxes where flush-mounted in concrete.
  - 4. Use suitable masonry type boxes where flush-mounted in masonry walls.
  - 5. Use raised covers suitable for the type of wall construction and device configuration where required.
  - 6. Use shallow boxes where required by the type of wall construction.
  - 7. Do not use "through-wall" boxes designed for access from both sides of wall.
  - 8. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
  - 9. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
  - 10. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
  - 11. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
  - 12. Wall Plates: Comply with Section 26 27 26.
- C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches (1,650 cu cm):
  - 1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
  - 2. NEMA 250 Environment Type, Unless Otherwise Indicated:
    - a. Indoor Clean, Dry Locations: Type 1, galvanized steel.
  - 3. Junction and Pull Boxes Larger Than 100 cubic inches (1,650 cu cm):
    - a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that mounting surfaces are ready to receive boxes.
- B. Verify that conditions are satisfactory for installation prior to starting work.

### **3.2 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

- D. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.
- E. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.
- F. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.
- G. Box Locations:
  - 1. Locate boxes to be accessible. Provide access panels in accordance with Section 08 31 00 as required where approved by the Architect.
  - 2. Unless dimensioned, box locations indicated are approximate.
  - 3. Locate boxes as required for devices installed under other sections or by others.
    - a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 26 27 26.
    - b. Communications Systems Outlets: Comply with Section 27 10 00.
  - 4. Locate boxes so that wall plates do not span different building finishes.
  - 5. Locate boxes so that wall plates do not cross masonry joints.
  - 6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
  - 7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches (150 mm) horizontal separation unless otherwise indicated.
  - 8. Acoustic-Rated Walls: Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches (610 mm) horizontal separation.
  - 9. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
    - a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches (610 mm) separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.
    - b. Do not install flush-mounted boxes with area larger than 16 square inches (0.0103 sq m) or such that the total aggregate area of openings exceeds 100 square inches (0.0645 sq m) for any 100 square feet (9.29 sq m) of wall area.
  - 10. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
    - a. Concealed above accessible suspended ceilings.
    - b. Within joists in areas with no ceiling.
    - c. Electrical rooms.
    - d. Mechanical equipment rooms.
- H. Box Supports:
  - 1. Secure and support boxes in accordance with NFPA 70 and Section 26 05 29 using suitable supports and methods approved by the authority having jurisdiction.
  - 2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
  - 3. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.

- I. Install boxes plumb and level.
- J. Flush-Mounted Boxes:
  - 1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch (6 mm) or does not project beyond finished surface.
  - 2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
  - 3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch (3 mm) at the edge of the box.
- K. Install boxes as required to preserve insulation integrity.
- L. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- M. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
- N. Close unused box openings.
- O. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
- P. Provide grounding and bonding in accordance with Section 26 05 26.
- Q. Identify boxes in accordance with Section 26 05 53.

### 3.3 CLEANING

- A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

### 3.4 PROTECTION

- A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

**END OF SECTION**

SECTION 26 05 53  
IDENTIFICATION FOR ELECTRICAL SYSTEMS

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Electrical identification requirements.
- B. Identification nameplates and labels.
- C. Wire and cable markers.
- D. Voltage markers.
- E. Underground warning tape.
- F. Warning signs and labels.

1.2 RELATED REQUIREMENTS

- A. Section 09 91 13 - Exterior Painting.
- B. Section 09 91 23 - Interior Painting.
- C. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.
- D. Section 26 27 26 - Wiring Devices - Lutron: Device and wallplate finishes; factory pre-marked wallplates.
- E. Section 27 10 00 - Structured Cabling: Identification for communications cabling and devices.

1.3 REFERENCE STANDARDS

- A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs; 2011.
- B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2011.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. NFPA 70E - Standard for Electrical Safety in the Workplace; 2024.
- E. UL 969 - Marking and Labeling Systems; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.
- B. Sequencing:
  - 1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
  - 2. Do not install identification products until final surface finishes and painting are complete.

1.5 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

## 1.6 FIELD CONDITIONS

- A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

## PART 2 PRODUCTS

### 2.1 IDENTIFICATION REQUIREMENTS

- A. Identification for Equipment:
  - 1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
    - a. Panelboards:
      - 1) Identify power source and circuit number. Include location.
      - 2) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
      - 3) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
    - b. Enclosed switches, circuit breakers, and motor controllers:
      - 1) Identify voltage and phase.
      - 2) Identify power source and circuit number. Include location.
      - 3) Identify load(s) served. Include location.
  - 2. Use identification nameplate to identify equipment utilizing series ratings, where permitted, in accordance with NFPA 70.
  - 3. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.
  - 4. Use identification label on inside of door at each fused switch to identify required NEMA fuse class and size.
  - 5. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70 including but not limited to the following.
    - a. Service equipment.
    - b. Industrial control panels.
    - c. Motor control centers.
    - d. Elevator control panels.
    - e. Industrial machinery.
  - 6. Use warning signs to identify electrical hazards for entrances to all rooms and other guarded locations that contain exposed live parts operating at 600 V nominal or less with the word message "DANGER; Electrical hazard; Authorized personnel only" or approved equivalent.
  - 7. Use warning labels to identify electrical hazards for equipment, compartments, and enclosures containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".

8. Use warning labels, identification nameplates, or identification labels to identify electrical hazards for equipment where multiple power sources are present with the word message "DANGER; Hazardous voltage; Multiple power sources may be present; Disconnect all electric power including remote disconnects before servicing" or approved equivalent.
- B. Identification for Conductors and Cables:
1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 05 19.
  2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
  3. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:
    - a. At each source and load connection.
    - b. Within boxes when more than one circuit is present.
    - c. Within equipment enclosures when conductors and cables enter or leave the enclosure.
  4. Use wire and cable markers to identify connected grounding electrode system components for grounding electrode conductors.
  5. Use underground warning tape to identify direct buried cables.
- C. Identification for Raceways:
1. Use voltage markers or color-coded bands to identify systems other than normal power system for accessible conduits at maximum intervals of 20 feet (6.1 m).
    - a. Color-Coded Bands: Use field-painting or vinyl color coding electrical tape to mark bands 3 inches (76 mm) wide.
      - 1) Color Code:
      - 2) Field-Painting: Comply with Section 09 91 23 and 09 91 13.
      - 3) Vinyl Color Coding Electrical Tape: Comply with Section 26 05 19.
  2. Use identification labels or plastic marker tags to identify circuits enclosed for accessible conduits at wall penetrations, at floor penetrations, at roof penetrations, and at equipment terminations when source is not within sight.
  3. Use identification labels or plastic marker tags to identify spare conduits at each end. Identify purpose and termination location.
  4. Use underground warning tape to identify underground raceways.
  5. Use voltage markers to identify highest voltage present for wireways at maximum intervals of 20 feet (6.1 m).
- D. Identification for Boxes:
1. Use voltage markers to identify highest voltage present.
  2. Use voltage markers or color coded boxes to identify systems other than normal power system.
    - a. Color-Coded Boxes: Field-painted in accordance with Section 09 91 23 and 09 91 13 per the same color code used for raceways.
  3. Use identification labels to identify circuits enclosed.

4. Use warning labels to identify electrical hazards for boxes containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".
- E. Identification for Devices:
1. Identification for Communications Devices: Comply with Section 27 10 00.
  2. Wiring Device and Wallplate Finishes: Comply with Section 26 27 26.
  3. Use identification label to identify fire alarm system devices.
    - a. For devices concealed above suspended ceilings, provide additional identification on ceiling tile below device location.
  4. Use identification label or engraved wallplate to identify serving branch circuit for all receptacles.
    - a. For receptacles in public areas or in areas as directed by Architect, provide identification on inside surface of wallplate.
  5. Use identification label or engraved wallplate to identify load controlled for wall-mounted control devices controlling loads that are not visible from the control location and for multiple wall-mounted control devices installed at one location.
  6. Use identification label to identify receptacles protected by upstream GFI protection, where permitted.
- F. Identification for Luminaires:
1. Use permanent red dot on luminaire frame to identify luminaires connected to emergency power system.

## 2.2 IDENTIFICATION NAMEPLATES AND LABELS

- A. Identification Nameplates:
1. Materials:
    - a. Indoor Clean, Dry Locations: Use plastic nameplates.
    - b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
  2. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch (1.6 mm); engraved text.
    - a. Exception: Provide minimum thickness of 1/8 inch (3 mm) when any dimension is greater than 4 inches (100 mm).
  3. Stainless Steel Nameplates: Minimum thickness of 1/32 inch (0.8 mm); engraved or laser-etched text.
  4. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch (0.8 mm); engraved or laser-etched text.
  5. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch (25 mm) high; Four, located at corners for larger sizes.
- B. Identification Labels:
1. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.

2. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.
- C. Format for Equipment Identification:
1. Minimum Size: 1 inch (25 mm) by 2.5 inches (64 mm).
  2. Legend:
    - a. Equipment designation or other approved description.
  3. Text: All capitalized unless otherwise indicated.
  4. Minimum Text Height:
    - a. Equipment Designation: 1/2 inch (13 mm).
  5. Color:
    - a. Normal Power System: White text on black background.
- D. Format for General Information and Operating Instructions:
1. Minimum Size: 1 inch (25 mm) by 2.5 inches (64 mm).
  2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
  3. Text: All capitalized unless otherwise indicated.
  4. Minimum Text Height: 1/4 inch (6 mm).
  5. Color: Black text on white background unless otherwise indicated.
- E. Format for Receptacle Identification:
1. Minimum Size: 3/8 inch (10 mm) by 1.5 inches (38 mm).
  2. Legend: Power source and circuit number or other designation indicated.
    - a. Include voltage and phase for other than 120 V, single phase circuits.
  3. Text: All capitalized unless otherwise indicated.
  4. Minimum Text Height: 3/16 inch (5 mm).
  5. Color: Black text on clear background.
- F. Format for Fire Alarm Device Identification:
1. Minimum Size: 3/8 inch (10 mm) by 1.5 inches (38 mm).
  2. Legend: Designation indicated and device zone or address.
  3. Text: All capitalized unless otherwise indicated.
  4. Minimum Text Height: 3/16 inch (5 mm).
  5. Color: Red text on white background.

## 2.3 WIRE AND CABLE MARKERS

- A. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.
- B. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.
- C. Legend: Power source and circuit number or other designation indicated.



- D. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
  - 1. Do not use handwritten text.
- E. Minimum Text Height: 1/8 inch (3 mm).
- F. Color: Black text on white background unless otherwise indicated.

#### 2.4 VOLTAGE MARKERS

- A. Markers for Conduits: Use factory pre-printed self-adhesive vinyl, self-adhesive vinyl cloth, or vinyl snap-around type markers.
- B. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.
- C. Minimum Size:
  - 1. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.
  - 2. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches (29 by 110 mm).
  - 3. Markers for Junction Boxes: 1/2 by 2 1/4 inches (13 by 57 mm).
- D. Legend:
  - 1. Markers for Voltage Identification: Highest voltage present.
  - 2. Markers for System Identification:
- E. Color: Black text on orange background unless otherwise indicated.

#### 2.5 UNDERGROUND WARNING TAPE

- A. Materials: Use foil-backed detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.
- B. Foil-backed Detectable Type Tape: 6 inches (152 mm) wide, with minimum thickness of 5 mil (0.1 mm), unless otherwise required for proper detection.
- C. Legend: Type of service, continuously repeated over full length of tape.
- D. Color:
  - 1. Tape for Buried Power Lines: Black text on red background.

#### 2.6 WARNING SIGNS AND LABELS

- A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.
- B. Warning Signs:
  - 1. Materials:
    - a. Indoor Dry, Clean Locations: Use factory pre-printed rigid plastic or self-adhesive vinyl signs.
    - b. Outdoor Locations: Use factory pre-printed rigid aluminum signs.
  - 2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.
  - 3. Minimum Size: 7 by 10 inches (178 by 254 mm) unless otherwise indicated.
- C. Warning Labels:
  - 1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.

- a. Do not use labels designed to be completed using handwritten text.
  - b. Provide polyester overlamine to protect handwritten text.
2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
  3. Minimum Size: 2 by 4 inches (51 mm by 102 mm) unless otherwise indicated.

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

### **3.2 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
  1. Surface-Mounted Equipment: Enclosure front.
  2. Flush-Mounted Equipment: Inside of equipment door.
  3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
  4. Elevated Equipment: Legible from the floor or working platform.
  5. Branch Devices: Adjacent to device.
  6. Interior Components: Legible from the point of access.
  7. Conduits: Legible from the floor.
  8. Boxes: Outside face of cover.
  9. Conductors and Cables: Legible from the point of access.
  10. Devices: Outside face of cover.
- C. Install identification products centered, level, and parallel with lines of item being identified.
- D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.
- E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.
- F. Install underground warning tape above buried lines with one tape per trench at 3 inches (75 mm) below finished grade.
- G. Secure rigid signs using stainless steel screws.
- H. Mark all handwritten text, where permitted, to be neat and legible.

### **3.3 FIELD QUALITY CONTROL**

- A. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

## **END OF SECTION**

SECTION 26 09 23  
LIGHTING CONTROL DEVICES

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Occupancy sensors.

1.2 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 29 - Hangers and Supports for Electrical Systems
- C. Section 26 05 33.16 - Boxes for Electrical Systems.
- D. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 26 27 26 - Wiring Devices: Devices for manual control of lighting, including wall switches, wall dimmers, and fan speed controllers.

1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
- C. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; 2023.
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate the placement of lighting control devices with millwork, furniture, equipment, etc. installed under other sections or by others.
  - 2. Coordinate the placement of wall switch occupancy sensors with actual installed door swings.
  - 3. Coordinate the placement of occupancy sensors with millwork, furniture, equipment or other potential obstructions to motion detection coverage installed under other sections or by others.
  - 4. Coordinate the placement of photo sensors for daylighting controls with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement installed under other sections or by others.
  - 5. Notify Architect/Engineer of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.
- B. Pre-Wire Meeting: Where Lighting Control Manufacturer Sensor Layout and Tuning service is specified in Part 2 under "LIGHTING CONTROLS - GENERAL REQUIREMENTS", sensor locations to be reviewed in accordance with layout provided by Lighting Control Manufacturer. Lighting Control Manufacturer may direct Contractor regarding sensor relocation should conditions require a deviation from locations indicated.

C. Sequencing:

1. Do not install lighting control devices until final surface finishes and painting are complete.

1.5 SUBMITTALS

A. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.

1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.

B. Shop Drawings:

1. Occupancy Sensors: Provide lighting plan indicating location, model number, and orientation of each occupancy sensor and associated system component.
2. Provide detailed wiring diagrams for each sequence of operation scheme used in the plans.

C. Field Quality Control Reports.

D. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Operation and Maintenance Data: Include detailed information on device programming and setup.

F. Project Record Documents: Record actual installed locations and settings for lighting control devices.

1.6 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.8 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.9 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Provide five year manufacturer warranty for all occupancy sensors.

## PART 2 PRODUCTS

### 2.1 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless specifically indicated to be excluded, provide all required conduit, wiring, connectors, hardware, components, accessories, etc. as required for a complete operating system.
- C. Products for Switching of Electronic Ballasts/Drivers: Tested and rated to be suitable for peak inrush currents specified in NEMA 410.

### 2.2 OCCUPANCY SENSORS

- A. All Occupancy Sensors:
  - 1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
  - 2. Sensor Technology:
    - a. Passive Infrared (PIR) Occupancy Sensors: Designed to detect occupancy by sensing movement of thermal energy between zones.
    - b. Passive Infrared/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and ultrasonic technologies.
  - 3. Provide LED to visually indicate motion detection with separate color LEDs for each sensor type in dual technology units.
  - 4. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during an adjustable turn-off delay time interval.
  - 5. Dual Technology Occupancy Sensors: Field configurable turn-on and hold-on activation with settings for activation by either or both sensing technologies.
  - 6. Passive Infrared Lens Field of View: Field customizable by addition of factory masking material, adjustment of integral blinders, or similar means to block motion detection in selected areas.
  - 7. Turn-Off Delay: Field adjustable, with time delay settings up to 30 minutes.
  - 8. Load Rating for Line Voltage Occupancy Sensors: As required to control the load indicated on drawings.
- B. Wall Switch Occupancy Sensors:
  - 1. All Wall Switch Occupancy Sensors:
    - a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated manual control capability, and no leakage current to load in off mode.
    - b. Where indicated, provide two-circuit units for control of two separate lighting loads, with separate manual controls and separately programmable operation for each load.
    - c. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).

- d. Manual-Off Override Control: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during the delayed-off time interval.
  - e. Finish: Match finishes specified for wiring devices in Section 26 27 26, unless otherwise indicated.
- C. Ceiling Mounted Occupancy Sensors:
- 1. All Ceiling Mounted Occupancy Sensors:
    - a. Description: Low profile occupancy sensors designed for ceiling installation.
    - b. Unless otherwise indicated or required to control the load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
    - c. Provide field selectable setting for disabling LED motion detector visual indicator.
    - d. Occupancy sensor to be field selectable as either manual-on/automatic-off or automatic on/off.
  - 2. Passive Infrared/Ultrasonic Dual Technology Ceiling Mounted Occupancy Sensors:
    - a. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet (111.5 sq m) at a mounting height of 9 feet (2.7 m), with a field of view of 360 degrees.
- D. Power Packs for Low Voltage Occupancy Sensors:
- 1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage occupancy sensors for switching of line voltage loads.
  - 2. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.
  - 3. Input Supply Voltage: Dual rated for 120/277 V ac.
  - 4. Load Rating: As required to control the load indicated on drawings.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.
- F. Verify that the service voltage and ratings of lighting control devices are appropriate for the service voltage and load requirements at the location to be installed.
- G. Verify that conditions are satisfactory for installation prior to starting work.

### 3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

### 3.3 INSTALLATION

- A. Install lighting control devices in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of lighting control devices provided under this section.
- C. Install lighting control devices in accordance with manufacturer's instructions.
- D. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- E. Install lighting control devices plumb and level, and held securely in place.
- F. Where required and not furnished with lighting control device, provide wall plate in accordance with Section 26 27 26.
- G. Provide required supports in accordance with Section 26 05 29.
- H. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
- I. Identify lighting control devices in accordance with Section 26 05 53.
- J. Occupancy Sensor Locations:
  - 1. Location Adjustments: Do not make adjustments to locations without obtaining approval from the Architect/Engineer.
  - 2. Locate ultrasonic and dual technology passive infrared/ultrasonic occupancy sensors a minimum of 6 feet (1.8 m) from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.

### 3.4 FIELD QUALITY CONTROL

- A. Inspect each lighting control device for damage and defects.
- B. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area. Record test results in written report to be included with submittals.
- C. Correct wiring deficiencies and replace damaged or defective lighting control devices.

### 3.5 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.
- B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Architect/Engineer.
- C. Where indicated or as directed by Architect, install factory masking material or adjust integral blinders on passive infrared (PIR) and dual technology occupancy sensor lenses to block undesired motion detection.

3.6 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.7 CLOSEOUT ACTIVITIES

- A. Demonstration: Demonstrate proper operation of lighting control devices to Architect/Engineer, and correct deficiencies or make adjustments as directed.

**END OF SECTION**



SECTION 26 24 16  
PANELBOARDS

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Power distribution panelboards.
- B. Lighting and appliance panelboards.
- C. Overcurrent protective devices for panelboards.

1.2 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 05 73 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.

1.3 REFERENCE STANDARDS

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e, with Amendments (2022).
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- C. NECA 407 - Standard for Installing and Maintaining Panelboards; 2015.
- D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2018.
- E. NEMA PB 1 - Panelboards; 2011.
- F. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 1000 Volts or Less; 2023.
- G. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- K. UL 67 - Panelboards; Current Edition, Including All Revisions.
- L. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

##### A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
5. Notify Architect/Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

#### 1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
  1. Include dimensioned plan and elevation views of panelboards and adjacent equipment with all required clearances indicated.
  2. Include wiring diagrams showing all factory and field connections.
  3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
- D. Source Quality Control Test Reports: Include reports for tests designated in NEMA PB 1 as routine tests.
- E. Field Quality Control Test Reports.
- F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- G. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.
- H. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  1. See Section 01 60 00 - Product Requirements, for additional provisions.
  2. Panelboard Keys: Two of each different key.

#### 1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

#### 1.8 FIELD CONDITIONS

- A. Maintain ambient temperature within the following limits during and after installation of panelboards:
  - 1. Panelboards Containing Circuit Breakers: Between 23 degrees F (-5 degrees C) and 104 degrees F (40 degrees C).

### **PART 2 PRODUCTS**

#### 2.1 MANUFACTURERS

- A. Eaton Corporation: [www.eaton.com/#sle](http://www.eaton.com/#sle).
- B. Schneider Electric; Square D Products: [www.schneider-electric.us/#sle](http://www.schneider-electric.us/#sle).
- C. Siemens Industry, Inc: [www.usa.siemens.com/#sle](http://www.usa.siemens.com/#sle).
- D. Source Limitations: Furnish panelboards and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

#### 2.2 PANELBOARDS - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
  - 1. Altitude: Less than 6,600 feet (2,000 m).
  - 2. Ambient Temperature:
    - a. Panelboards Containing Circuit Breakers: Between 23 degrees F (-5 degrees C) and 104 degrees F (40 degrees C).
- C. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.
- D. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.
- E. Busking: Sized in accordance with UL 67 temperature rise requirements.
  - 1. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
- F. Conductor Terminations: Suitable for use with the conductors to be installed.

- G. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
  - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
    - a. Indoor Clean, Dry Locations: Type 1.
    - b. Outdoor Locations: Type 3R.
  - 2. Boxes: Galvanized steel unless otherwise indicated.
    - a. Provide wiring gutters sized to accommodate the conductors to be installed.
  - 3. Fronts:
    - a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
    - b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
    - c. Finish for Painted Steel Fronts: Manufacturer's standard grey unless otherwise indicated.
  - 4. Lockable Doors: All locks keyed alike unless otherwise indicated.
- H. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
- I. Multi-Section Panelboards: Provide enclosures of the same height, with feed-through lugs or sub-feed lugs and feeders as indicated or as required to interconnect sections.
- J. Load centers are not acceptable.
- K. Provide the following features and accessories where indicated or where required to complete installation:
  - 1. Feed-through lugs.
  - 2. Sub-feed lugs.

### 2.3 LIGHTING AND APPLIANCE PANELBOARDS

- A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated.
- B. Conductor Terminations:
  - 1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
  - 2. Main and Neutral Lug Type: Mechanical.
- C. Bussing:
  - 1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
  - 2. Phase and Neutral Bus Material: Aluminum.
  - 3. Ground Bus Material: Aluminum.
- D. Circuit Breakers: Thermal magnetic bolt-on type.
- E. Enclosures:
  - 1. Provide surface-mounted enclosures.

2. Fronts: Provide lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
3. Provide clear plastic circuit directory holder mounted on inside of door.

## 2.4 OVERCURRENT PROTECTIVE DEVICES

### A. Molded Case Circuit Breakers:

1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489 and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
2. Interrupting Capacity:
  - a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
    - 1) 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
    - 2) 14,000 rms symmetrical amperes at 480 VAC.
  - b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
3. Conductor Terminations:
  - a. Provide mechanical lugs unless otherwise indicated.
  - b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
5. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
6. Provide listed switching duty rated circuit breakers with SWD marking for all lighting circuits.
7. Do not use tandem circuit breakers.
8. Do not use handle ties in lieu of multi-pole circuit breakers.

## 2.5 SOURCE QUALITY CONTROL

- A. Factory test panelboards according to NEMA PB 1.

## **PART 3 EXECUTION**

### 3.1 EXAMINATION

- A. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.
- B. Verify that mounting surfaces are ready to receive panelboards.
- C. Coordinate the panelboard and the surface to be mounted on or in.
- D. Verify that conditions are satisfactory for installation prior to starting work.

### 3.2 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).

- B. Install products in accordance with manufacturer's instructions.
- C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.
- D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- E. Provide required supports in accordance with Section 26 05 29.
- F. Install panelboards plumb.
- G. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.
- H. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches (2000 mm) above the floor or working platform.
- I. Provide minimum of six spare 1 inch (27 mm) trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.
- J. Provide grounding and bonding in accordance with Section 26 05 26.
- K. Install all field-installed branch devices, components, and accessories.
- L. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- M. Set field-adjustable circuit breaker tripping function settings as determined by overcurrent protective device coordination study performed according to Section 26 05 73.
- N. Provide filler plates to cover unused spaces in panelboards.
- O. Identify panelboards in accordance with Section 26 05 53.

### 3.3 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than 250 amperes. Tests listed as optional are not required.
- C. Correct deficiencies and replace damaged or defective panelboards or associated components.

### 3.4 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- B. Adjust alignment of panelboard fronts.
- C. Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

### 3.5 CLEANING

- A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

**END OF SECTION**

SECTION 26 27 26  
WIRING DEVICES

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Wall switches.
- B. Receptacles.
- C. Wall plates.

1.2 RELATED REQUIREMENTS

- A. Section 26 05 33.16 - Boxes for Electrical Systems.
- B. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- C. Section 27 10 00 - Structured Cabling: Voice and data jacks.

1.3 REFERENCE STANDARDS

- A. FS W-C-596 - Connector, Electrical, Power, General Specification for; 2014h, with Amendments (2017).
- B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification); 2014g, with Amendment (2017).
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- D. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
- E. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).
- F. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2021.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.
- I. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.
- J. UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.
- K. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.
- L. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.
- M. UL 1917 - Solid-State Fan Speed Controls; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
  - 2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.

3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.
  4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
  5. Notify Architect/Engineer of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.
- B. Sequencing:
1. Do not install wiring devices until final surface finishes and painting are complete.

#### 1.5 SUBMITTALS

- A. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
- B. Field Quality Control Test Reports.
- C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- D. Operation and Maintenance Data:
  1. GFCI Receptacles: Include information on status indicators.
- E. Project Record Documents: Record actual installed locations of wiring devices.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

#### 1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Products: Listed, classified, and labeled as suitable for the purpose intended.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

#### 1.7 DELIVERY, STORAGE, AND PROTECTION

- A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

### **PART 2 PRODUCTS**

#### 2.1 WIRING DEVICE APPLICATIONS

- A. Provide wiring devices suitable for intended use and with ratings adequate for load served.
- B. Provide weather resistant GFCI receptacles with specified weatherproof covers for receptacles installed outdoors or in damp or wet locations.
- C. Provide GFCI protection for receptacles installed within 6 feet (1.8 m) of sinks.
- D. Provide GFCI protection for receptacles installed in kitchens.



- E. Provide GFCI protection for receptacles serving electric drinking fountains.

## 2.2 WIRING DEVICE FINISHES

- A. Provide wiring device finishes as described below unless otherwise indicated.
- B. Wiring Devices, Unless Otherwise Indicated: Gray with stainless steel wall plate.
- C. Wiring Devices Installed in Unfinished Spaces: Gray with galvanized steel wall plate.
- D. Wiring Devices Installed in Wet or Damp Locations: Gray with specified weatherproof cover.

## 2.3 WALL SWITCHES

- A. Manufacturers:
  - 1. Hubbell Incorporated: [www.hubbell.com/#sle](http://www.hubbell.com/#sle).
  - 2. Cooper Wiring Devices
  - 3. Leviton Manufacturing Company, Inc: [www.leviton.com/#sle](http://www.leviton.com/#sle).
  - 4. Lutron
  - 5. Pass & Seymour, a brand of Legrand North America, Inc: [www.legrand.us/#sle](http://www.legrand.us/#sle).
- B. Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable FS W-S-896; types as indicated on the drawings.
  - 1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.
- C. Standard Wall Switches: Industrial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

## 2.4 RECEPTACLES

- A. Manufacturers:
  - 1. Hubbell Incorporated: [www.hubbell.com/#sle](http://www.hubbell.com/#sle).
  - 2. Cooper Wiring Devices.
  - 3. Leviton Manufacturing Company, Inc: [www.leviton.com/#sle](http://www.leviton.com/#sle).
  - 4. Lutron Electronics Company, Inc: [www.lutron.com/sle](http://www.lutron.com/sle).
  - 5. Pass & Seymour, a brand of Legrand North America, Inc: [www.legrand.us/#sle](http://www.legrand.us/#sle).
- B. Receptacles - General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.
  - 1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
  - 2. NEMA configurations specified are according to NEMA WD 6.
- C. Convenience Receptacles:
  - 1. Standard Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
  - 2. Tamper Resistant and Weather Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.

D. GFCI Receptacles:

1. GFCI Receptacles - General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.
  - a. Provide test and reset buttons of same color as device.
2. Standard GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.
3. Tamper Resistant and Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations.

2.5 WALL PLATES

A. Manufacturers:

1. Hubbell Incorporated: [www.hubbell-wiring.com/#sle](http://www.hubbell-wiring.com/#sle).
2. Leviton Manufacturing Company, Inc: [www.leviton.com/#sle](http://www.leviton.com/#sle).
3. Lutron Electronics Company, Inc: [www.lutron.com/sle](http://www.lutron.com/sle).
4. Pass & Seymour, a brand of Legrand North America, Inc: [www.legrand.us/#sle](http://www.legrand.us/#sle).
5. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer.

B. Wall Plates: Comply with UL 514D.

1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
2. Size: Standard.
3. Screws: Metal with slotted heads finished to match wall plate finish.

C. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.

D. Galvanized Steel Wall Plates: Rounded corners and edges, with corrosion resistant screws.

E. Premarked Wall Plates: Factory labeled as indicated; hot stamped for nylon wall plates and engraved for metal wall plates.

F. Weatherproof Covers for Wet or Damp Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.

**PART 3 EXECUTION**

3.1 EXAMINATION

- A. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- B. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- C. Verify that final surface finishes are complete, including painting.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- E. Verify that conditions are satisfactory for installation prior to starting work.

### 3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

### 3.3 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of wiring devices provided under this section.
  - 1. Mounting Heights: Unless otherwise indicated, as follows:
    - a. Wall Switches: 48 inches (1200 mm) above finished floor.
    - b. Wall Dimmers: 48 inches (1200 mm) above finished floor.
    - c. Receptacles: 18 inches (450 mm) above finished floor or 6 inches (150 mm) above counter.
  - 2. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
  - 3. Where multiple receptacles, wall switches, or wall dimmers are installed at the same location and at the same mounting height, gang devices together under a common wall plate.
  - 4. Locate wall switches on strike side of door with edge of wall plate 3 inches (80 mm) from edge of door frame. Where locations are indicated otherwise, notify Architect/Engineer to obtain direction prior to proceeding with work.
  - 5. Locate receptacles for electric drinking fountains concealed behind drinking fountain according to manufacturer's instructions.
- C. Install wiring devices in accordance with manufacturer's instructions.
- D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- E. Where required, connect wiring devices using pigtails not less than 6 inches (150 mm) long. Do not connect more than one conductor to wiring device terminals.
- F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.
- G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- H. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.
- I. Install wiring devices plumb and level with mounting yoke held rigidly in place.
- J. Install wall switches with OFF position down.
- K. Install vertically mounted receptacles with grounding pole on bottom and horizontally mounted receptacles with grounding pole on left.
- L. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

- M. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.
- N. Identify wiring devices in accordance with Section 26 05 53.

#### 3.4 FIELD QUALITY CONTROL

- A. Inspect each wiring device for damage and defects.
- B. Operate each wall switch, wall dimmer, and fan speed controller with circuit energized to verify proper operation.
- C. Test each receptacle to verify operation and proper polarity.
- D. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.
- E. Correct wiring deficiencies and replace damaged or defective wiring devices.

#### 3.5 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

#### 3.6 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

**END OF SECTION**

SECTION 26 28 16.16  
ENCLOSED SWITCHES

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Enclosed safety switches.

1.2 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 05 73 - Power System Studies: Additional criteria for the selection of equipment and associated protective devices specified in this section.
- E. Section 26 28 13 - Fuses.

1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2018.
- C. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.
- D. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- H. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
  - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
  - 3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
  - 4. Notify Architect/Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

## 1.5 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.
- B. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
  - 1. Include dimensioned plan and elevation views of enclosed switches and adjacent equipment with all required clearances indicated.
  - 2. Include wiring diagrams showing all factory and field connections.
- C. Field Quality Control Test Reports.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
- E. Project Record Documents: Record actual locations of enclosed switches.
- F. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 60 00 - Product Requirements, for additional provisions.

## 1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

## 1.8 FIELD CONDITIONS

- A. Maintain ambient temperature between -22 degrees F (-30 degrees C) and 104 degrees F (40 degrees C) during and after installation of enclosed switches.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Eaton Corporation: [www.eaton.com](http://www.eaton.com).
- B. Schneider Electric; Square D Products: [www.schneider-electric.us](http://www.schneider-electric.us).

- C. Siemens Industry, Inc: [www.usa.siemens.com](http://www.usa.siemens.com).
- D. Source Limitations: Furnish enclosed switches and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

## 2.2 ENCLOSED SAFETY SWITCHES

- A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
  - 1. Altitude: Less than 6,600 feet (2,000 m).
  - 2. Ambient Temperature: Between -22 degrees F (-30 degrees C) and 104 degrees F (40 degrees C).
- D. Horsepower Rating: Suitable for connected load.
- E. Voltage Rating: Suitable for circuit voltage.
- F. Short Circuit Current Rating:
  - 1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 26 05 73.
- G. Provide with switch blade contact position that is visible when the cover is open.
- H. Fuse Clips for Fusible Switches: As required to accept fuses indicated.
  - 1. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.
- I. Conductor Terminations: Suitable for use with the conductors to be installed.
- J. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.
- K. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
  - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
    - a. Indoor Clean, Dry Locations: Type 1.
    - b. Outdoor Locations: Type 3R.
- L. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
- M. Heavy Duty Switches:
  - 1. Comply with NEMA KS 1.
  - 2. Conductor Terminations:
    - a. Provide mechanical lugs unless otherwise indicated.
    - b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.

3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.
  - a. Provide means for locking handle in the ON position.
- N. Provide the following features and accessories where indicated or where required to complete installation:
  1. Hubs: As required for environment type; sized to accept conduits to be installed.
  2. Auxiliary Switch: SPDT switch suitable for connection to system indicated, with auxiliary contact operation before switch blades open and after switch blades close.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive enclosed safety switches.
- D. Verify that conditions are satisfactory for installation prior to starting work.

### **3.2 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required supports in accordance with Section 26 05 29.
- E. Install enclosed switches plumb.
- F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches (2000 mm) above the floor or working platform.
- G. Provide grounding and bonding in accordance with Section 26 05 26.
- H. Provide fuses complying with Section 26 28 13 for fusible switches as indicated or as required by equipment manufacturer's recommendations.
- I. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- J. Identify enclosed switches in accordance with Section 26 05 53.

### **3.3 FIELD QUALITY CONTROL**

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.
- C. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

### **3.4 ADJUSTING**

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.



3.5 CLEANING

- A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

**END OF SECTION**

SECTION 26 51 00  
INTERIOR LIGHTING

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Interior luminaires.
- B. Exit signs.
- C. Ballasts and drivers.
- D. Lamps.
- E. Luminaire accessories.

1.2 RELATED REQUIREMENTS

- A. Section 26 05 33.16 - Boxes for Electrical Systems.
- B. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- C. Section 26 09 23 - Lighting Control Devices: Automatic controls for lighting including occupancy sensors, outdoor motion sensors, time switches, outdoor photo controls, and daylighting controls.
- D. Section 26 27 26 - Wiring Devices: Manual wall switches and wall dimmers.

1.3 REFERENCE STANDARDS

- A. 47 CFR 15 - Radio Frequency Devices; current edition.
- B. ANSI C82.11 - American National Standard for Lamp Ballasts - High Frequency Fluorescent Lamp Ballasts; 2023.
- C. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Corrigendum 2012).
- D. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products; 2019.
- E. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources; 2021.
- F. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- G. NECA/IESNA 500 - Standard for Installing Indoor Lighting Systems; 2006.
- H. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems; 2006.
- I. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; 2023.
- J. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility; 2023.
- K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- L. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- M. UL 1598C - Light-Emitting Diode (LED) Retrofit Luminaire Conversion Kits; Current Edition, Including All Revisions.

- N. UL 1598 - Luminaires; Current Edition, Including All Revisions.
- O. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
  - 2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
  - 3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.
  - 4. Notify Architect/Engineer of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.
- B. Shop Drawings:
  - 1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
  - 2. Provide photometric calculations where luminaires are proposed for substitution upon request.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.
  - 1. LED Luminaires:
    - a. Include estimated useful life, calculated based on IES LM-80 test data.
    - b. Include IES LM-79 test report upon request.
  - 2. Ballasts: Include wiring diagrams and list of compatible lamp configurations.
  - 3. Lamps: Include rated life, color temperature, color rendering index (CRI), and initial and mean lumen output.
- D. Certificates for Dimming Ballasts: Manufacturer's documentation of compatibility with dimming controls to be installed.
- E. Field quality control reports.

#### 1.5 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

#### 1.6 DELIVERY, STORAGE, AND PROTECTION

- A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

#### 1.7 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

#### 1.8 WARRANTY

- A. Provide five-year manufacturer warranty for all LED luminaires, including drivers.
- B. Provide three-year full warranty for fluorescent emergency power supply units.

### **PART 2 PRODUCTS**

#### 2.1 LUMINAIRE TYPES

- A. Furnish products as indicated in luminaire schedule included on the drawings.

#### 2.2 LUMINAIRES

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- G. Recessed Luminaires:
  - 1. Ceiling Compatibility: Comply with NEMA LE 4.
  - 2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.
  - 3. Luminaires Recessed in Sloped Ceilings: Provide suitable sloped ceiling adapters.
- H. LED Luminaires:
  - 1. Components: UL 8750 recognized or listed as applicable.
  - 2. Tested in accordance with IES LM-79 and IES LM-80.

3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

## 2.3 EXIT SIGNS

- A. Description: Internally illuminated exit signs with LEDs unless otherwise indicated; complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
  1. Number of Faces: Single or double as indicated or as required for the installed location.
  2. Directional Arrows: As indicated or as required for the installed location.
- B. Self-Powered Exit Signs:
  1. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
  2. Battery: Sealed maintenance-free nickel cadmium unless otherwise indicated.
  3. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
  4. Provide low-voltage disconnect to prevent battery damage from deep discharge.
  5. Self-Diagnostics: Provide units that self-monitor functionality and automatically perform testing required by NFPA 101; provide indicator light(s) to report test and diagnostic status.

## 2.4 BALLASTS AND DRIVERS

- A. Ballasts/Drivers - General Requirements:
  1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
  2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.
  3. Electronic Ballasts/Drivers: Inrush currents not exceeding peak currents specified in NEMA 410.
  4. Operate for at least 50,000 hours at maximum case temperature and 90 percent non-condensing relative humidity.
  5. Provide thermal fold-back protection by automatically reducing power output (dimming) to protect LED driver and LED light engine/fixture from damage due to over-temperature conditions that approach or exceed the LED driver's maximum operating temperature at calibration point
  6. Provide integral recording of operating hours and maximum operating temperature to aid in troubleshooting and warranty claims.
  7. Designed and tested to withstand electrostatic discharges incurred during manufacturing, installation, or field troubleshooting without impairment of performance when tested according to IEC 61000-4-2.
  8. Manufactured in a facility that employs ESD reduction practices in compliance with ANSI/ESD S20.20.
  9. UL 8750 recognized or listed as applicable.
  10. NRTL Type TL rated where possible to allow for easier fixture evaluation and listing of different driver series.

11. UL 1598C listed for field replacement as applicable.
  12. Designed and tested to withstand Category A surges of 4,000 V according to IEEE C62.41.2 without impairment of performance.
  13. Class A sound rating; inaudible in a 27 dBA ambient.
  14. Demonstrate no visible change in light output with a variation of plus or minus 10 percent change in line-voltage input.
  15. LED drivers of the same family/series to track evenly across multiple fixtures at all light levels.
  16. Employ integral fault protection up to 277 V to prevent LED driver damage or failure in the event of incorrect application of line-voltage to communication link inputs.
- B. LED Drivers
1. Operate from input voltage of 120 V through 277 V at 50/60 Hz.
  2. Complies with FCC requirements of 47 CFR 15, for commercial applications at 120-277 V and residential applications at 120 V.
  3. Total Harmonic Distortion (THD): Less than 20 percent at maximum power; complies with ANSI C82.11.
  4. Class 2 output designed to withstand hot swap of LED loads; meets UL 1310 and CSA C22.2 No. 223.
  5. Driver outputs to be short circuit protected, open circuit protected, and overload protected.
- C. Dimmable LED Drivers:
1. Dimming Range: Continuous dimming from 100 percent to five percent relative light output unless dimming capability to lower level is indicated, without flicker.
  2. Control Compatibility: Fully compatible with the dimming controls to be installed.
    - a. Wall Dimmers: See Section 26 27 26.
    - b. Daylighting Controls: See Section 26 09 23.
    - c. Network Lighting Controls: See Section 26 0923.

## 2.5 LAMPS

- A. Lamps - General Requirements:
1. Unless explicitly excluded, provide new, compatible, operable lamps in each luminaire.
  2. Verify compatibility of specified lamps with luminaires to be installed. Where lamps are not specified, provide lamps per luminaire manufacturer's recommendations.
  3. Minimum Efficiency: Provide lamps complying with all current applicable federal and state lamp efficiency standards.
  4. Color Temperature Consistency: Unless otherwise indicated, for each type of lamp furnish products which are consistent in perceived color temperature. Replace lamps that are determined by the Architect/Engineer to be inconsistent in perceived color temperature.

## 2.6 ACCESSORIES

- A. Stems for Suspended Luminaires: Steel tubing, minimum 1/2" size, factory finished to match luminaire or field-painted as directed.
- B. Threaded Rods for Suspended Luminaires: Zinc-plated steel, minimum 1/4" size, field-painted as directed.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

### **3.2 PREPARATION**

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

### **3.3 INSTALLATION**

- A. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of luminaires provided under this section.
- B. Install products in accordance with manufacturer's instructions.
- C. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting) and NECA 502 (industrial lighting).
- D. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- E. Suspended Ceiling Mounted Luminaires:
  - 1. Do not use ceiling tiles to bear weight of luminaires.
  - 2. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.
  - 3. Secure surface-mounted and pendant-mounted luminaires to building structure.
  - 4. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.
  - 5. In addition to ceiling support wires, provide two galvanized steel safety wire(s), minimum 12 gage, connected from opposing corners of each recessed luminaire to building structure.
  - 6. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.
- F. Recessed Luminaires:
  - 1. Install trims tight to mounting surface with no visible light leakage.
  - 2. Luminaires Recessed in Fire-Rated Ceilings: Install using accessories and firestopping materials to meet regulatory requirements for fire rating.
- G. Suspended Luminaires:
  - 1. Unless otherwise indicated, specified mounting heights are to bottom of luminaire.
  - 2. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.

3. Provide minimum of two supports for each luminaire equal to or exceeding 4 feet nominal length, with no more than 4 feet (1.2 m) between supports.
  4. Unless otherwise indicated, support pendants from swivel hangers.
- H. Install accessories furnished with each luminaire.
- I. Bond products and metal accessories to branch circuit equipment grounding conductor.
- J. Fluorescent Luminaires Controlled by Dual-Level Switching: Connect such that each switch controls the same corresponding lamps in each luminaire.
- K. Exit Signs:
1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.

### 3.4 FIELD QUALITY CONTROL

- A. Inspect each product for damage and defects.
- B. Operate each luminaire after installation and connection to verify proper operation.
- C. Test fluorescent emergency power supply units to verify proper operation upon loss of normal power supply.
- D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect/Engineer.

### 3.5 ADJUSTING

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect/Engineer. Secure locking fittings in place.
- B. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Architect/Engineer or authority having jurisdiction.

### 3.6 CLEANING

- A. Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

### 3.7 CLOSEOUT ACTIVITIES

- A. Just prior to Substantial Completion, replace all lamps that have failed.

### 3.8 PROTECTION

- A. Protect installed luminaires from subsequent construction operations.

**END OF SECTION**



SECTION 26 56 00  
EXTERIOR LIGHTING

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Exterior luminaires.
- B. Ballasts.
- C. Lamps.
- D. Poles and accessories.

1.2 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Materials and installation requirements for concrete bases for poles.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- C. Section 26 05 33.16 - Boxes for Electrical Systems.

1.3 REFERENCE STANDARDS

- A. AASHTO LTS - Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals; 2013, with Editorial Revision (2022).
- B. ANSI C82.4 - American National Standard for Lamp Ballasts - Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps; 2017, with Editorial Revision (2022).
- C. IEEE C2 - National Electrical Safety Code(R) (NESC(R)); 2023.
- D. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products; 2019.
- E. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources; 2021.
- F. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- G. NECA/IESNA 501 - Standard for Installing Exterior Lighting Systems; 2000 (Reaffirmed 2006).
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. UL 1029 - High-Intensity-Discharge Lamp Ballasts; Current Edition, Including All Revisions.
- J. UL 1598 - Luminaires; Current Edition, Including All Revisions.
- K. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate placement of poles and associated foundations with utilities, curbs, sidewalks, trees, walls, fences, striping, etc. installed under other sections or by others. Coordinate elevation to obtain specified foundation height.
  - 2. Notify Architect/Engineer of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

## 1.5 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, weight, effective projected area (EPA), and installed accessories; include model number nomenclature clearly marked with all proposed features.
  - 1. LED Luminaires:
    - a. Include estimated useful life, calculated based on IES LM-80 test data.
  - 2. Lamps: Include rated life and initial and mean lumen output.
  - 3. Poles: Include information on maximum supported effective projected area (EPA) and weight for the design wind speed.
- B. Certificates for Poles and Accessories: Manufacturer's documentation that products are suitable for the luminaires to be installed and comply with designated structural design criteria.
- C. Field Quality Control Reports.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
- E. Operation and Maintenance Data: Instructions for each product including information on replacement parts.
- F. Project Record Documents: Record actual connections and locations of pole foundations, luminaires, and any pull or junction boxes.

## 1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, handle, and store products according to NECA/IESNA 501 and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

## 1.8 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide five-year manufacturer warranty for all LED luminaires, including drivers.

## PART 2 PRODUCTS

### 2.1 LUMINAIRE TYPES

- A. Furnish products as indicated in luminaire schedule included on the drawings.

## 2.2 LUMINAIRES

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, poles, foundations, supports, trims, accessories, etc. as necessary for a complete operating system.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- G. LED Luminaires:
  - 1. Components: UL 8750 recognized or listed as applicable.
  - 2. Tested in accordance with IES LM-79 and IES LM-80.
  - 3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

## 2.3 BALLASTS

- A. Ballasts/Drivers - General Requirements:
  - 1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
  - 2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.
- B. LED Drivers: RoHS compliant, 120-277V input voltage, 0-10V dimming,
  - 1. LED Driver is certified by UL Class 2 for use in dry or damp location.
  - 2. LED Driver has a Class A sound rating.
  - 3. LED Driver has a minimum operating ambient temperature of -40C.
  - 4. LED Driver has a life expectancy of 50,000 hours at Tcase of  $\leq 70C$ .
  - 5. LED Driver tolerates sustained open circuit and short circuit output conditions without damage.
  - 6. LED Driver complies with FCC rules and regulations, as per Title 47 CFR Part 15 Non-Consumer (Class A).

## 2.4 LAMPS

- A. Lamps - General Requirements:
  - 1. Unless explicitly excluded, provide new, compatible, operable lamps in each luminaire.
  - 2. Verify compatibility of specified lamps with luminaires to be installed. Where lamps are not specified, provide lamps per luminaire manufacturer's recommendations.
  - 3. Minimum Efficiency: Provide lamps complying with all current applicable federal and state lamp efficiency standards.
  - 4. Color Temperature Consistency: Unless otherwise indicated, for each type of lamp furnish products which are consistent in perceived color temperature. Replace lamps that are determined by the Architect/Engineer to be inconsistent in perceived color temperature.

## 2.5 POLES

### A. All Poles:

1. Provide poles and associated support components suitable for the luminaire(s) and associated supports and accessories to be installed.
2. Structural Design Criteria:
  - a. Comply with AASHTO LTS.
  - b. Wind Load: Include effective projected area (EPA) of luminaire(s) and associated supports and accessories to be installed.
    - 1) Design Wind Speed: 100 miles per hour, with gust factor of 1.3.
  - c. Dead Load: Include weight of proposed luminaire(s) and associated supports and accessories.
3. Material: Steel, unless otherwise indicated.
4. Shape: Round tapered, unless otherwise indicated.
5. Finish: Match luminaire finish, unless otherwise indicated.
6. Mounting: Install on concrete foundation, height as indicated on the drawings, unless otherwise indicated.
7. Unless otherwise indicated, provide with the following features/accessories:
  - a. Anchor bolts with leveling nuts.
  - b. Anchor base cover.

### B. Metal Poles: Provide ground lug, accessible from handhole.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

### 3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

### 3.3 INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of luminaires provided under this section.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install products in accordance with manufacturer's instructions.

- D. Install luminaires in accordance with NECA/IESNA 501.
- E. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- F. Pole-Mounted Luminaires:
  - 1. Maintain the following minimum clearances:
    - a. Comply with IEEE C2.
    - b. Comply with utility company requirements.
  - 2. Foundation-Mounted Poles:
    - a. Provide cast-in-place concrete foundations for poles as indicated, in accordance with Section 03 30 00.
      - 1) Install anchor bolts plumb per template furnished by pole manufacturer.
      - 2) Position conduits to enter pole shaft.
    - b. Install foundations plumb.
    - c. Install poles plumb, using leveling nuts or shims as required to adjust to plumb.
    - d. Tighten anchor bolt nuts to manufacturer's recommended torque.
    - e. Install non-shrink grout between pole anchor base and concrete foundation, leaving small channel for condensation drainage.
    - f. Install anchor base covers or anchor bolt covers as indicated.
  - 3. Grounding:
    - a. Bond luminaires, metal accessories, metal poles, and foundation reinforcement to branch circuit equipment grounding conductor.
    - b. Provide supplementary ground rod electrode as specified in Section 26 05 26 at each pole bonded to grounding system as indicated.
  - 4. Install separate service conductors, 12 AWG copper, from each luminaire down to handhole for connection to branch circuit conductors.
- G. Install accessories furnished with each luminaire.
- H. Bond products and metal accessories to branch circuit equipment grounding conductor.
- I. Install lamps in each luminaire.

### 3.4 FIELD QUALITY CONTROL

- A. Inspect each product for damage and defects.
- B. Operate each luminaire after installation and connection to verify proper operation.
- C. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect/Engineer.

### 3.5 ADJUSTING

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect/Engineer. Secure locking fittings in place.
- B. Luminaires with Field-Rotatable Optics: Position optics according to manufacturer's instructions to achieve lighting distribution as indicated or as directed by Architect/Engineer.

3.6 CLEANING

- A. Clean surfaces according to NECA/IESNA 501 and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.7 CLOSEOUT ACTIVITIES

- A. Demonstration: Demonstrate proper operation of luminaires to Architect/Engineer, and correct deficiencies or make adjustments as directed.
- B. Just prior to Substantial Completion, replace all lamps that have failed.

3.8 PROTECTION

- A. Protect installed luminaires from subsequent construction operations.

**END OF SECTION**

SECTION 27 05 28  
PATHWAYS FOR COMMUNICATIONS SYSTEMS

**PART 1 GENERAL**

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

- A. Section Includes:
  - 1. Metal conduits and fittings.

**PART 2 PRODUCTS**

2.1 METAL CONDUITS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
- B. General Requirements for Metal Conduits and Fittings:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. EMT: Comply with ANSI C80.3 and UL 797.
- E. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
  - 1. Fittings for EMT:
    - a. Material: Steel.
    - b. Type: compression.
  - 2. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.
- F. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Alpha Wire Company.
  - 2. COMSCOPE
  - 3. Lamson & Sessions; Carlon Electrical Products.
  - 4. OTRONICS; LEGRAND
  - 5. PANDUIT

- B. Description: Comply with UL 2024; flexible-type pathway, approved for plenum installation unless otherwise indicated.
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

### 2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Cooper B-Line, Inc.
  - 2. Hoffman; a Pentair company.
  - 3. Mono-Systems, Inc.
  - 4. Square D; a brand of Schneider Electric.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.
  - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Hinged type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

### 2.4 BOXES, ENCLOSURES, AND CABINETS

- A. General Requirements for Boxes, Enclosures, and Cabinets:
  - 1. Comply with TIA-569-B.
  - 2. Boxes, enclosures and cabinets installed in wet locations shall be listed for use in wet locations.
- B. Sheet-Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- C. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- D. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- E. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- F. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep).
- G. Gangable boxes are prohibited.
- H. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
  - 1. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- I. Cabinets:
  - 1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
  - 2. Hinged door in front cover with flush latch and concealed hinge.



## PART 3 EXECUTION

### 3.1 PATHWAY APPLICATION

- A. Outdoors: Apply pathway products as specified below unless otherwise indicated:
  - 1. Exposed Conduit: GRC.
- B. Indoors: Apply pathway products as specified below unless otherwise indicated:
  - 1. Exposed, Not Subject to Physical Damage: EMT.
  - 2. Exposed, Not Subject to Severe Physical Damage: EMT.
  - 3. Exposed and Subject to Severe Physical Damage: GRC. Pathway locations include the following:
  - 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
  - 5. Damp or Wet Locations: GRC.
  - 6. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical-fiber-cable pathway.
  - 7. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: Riser-type, optical-fiber-cable pathway.
  - 8. Boxes and Enclosures: NEMA 250 Type 1, except use NEMA 250 Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Pathway Size: 1-inch (27-mm) trade size. Minimum size for optical-fiber cables is 1 inch (27 mm).
- D. Pathway Fittings: Compatible with pathways and suitable for use and location.
  - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
  - 2. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.

### 3.2 INSTALLATION

- A. Comply with NECA 1, NECA 101, and TIA-569-B for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum pathways. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.
- B. Keep pathways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.
- C. Complete pathway installation before starting conductor installation.
- D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches (300 mm) of changes in direction. Utilize long radius ells for all optical-fiber cables.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches (300 mm) of enclosures to which attached.
- I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.

- J. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- K. Cut conduit perpendicular to the length. For conduits of 2-inch (53-mm) trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.
- L. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground pathways designated as spare above grade alongside pathways in use.
- M. Mount boxes at heights 18 in, unless indicated otherwise on drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

### 3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

### 3.4 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

### 3.5 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage or deterioration.
  - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

**END OF SECTION**

SECTION 27 15 00  
COMMUNICATIONS HORIZONTAL CABLING

**PART 1 GENERAL**

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
  - 1. UTP cabling.
  - 2. Coaxial cable.
  - 3. Multiuser telecommunications outlet assemblies.
  - 4. Cable connecting hardware, patch panels, and cross-connects.
  - 5. Telecommunications outlet/connectors.
  - 6. Cabling system identification products.
  - 7. Cable management system.
- B. Related Requirements:
  - 1. Section 271300 "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.
  - 2. Section 280513 "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.
- C. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- D. EMI: Electromagnetic interference.
- E. IDC: Insulation displacement connector.
- F. LAN: Local area network.
- G. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications outlet/connectors.
- H. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.
- I. RCDD: Registered Communications Distribution Designer.
- J. UTP: Unshielded twisted pair.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate layout and installation of telecommunications cabling with Owner's telecommunications and LAN equipment and service suppliers.

- B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. For coaxial cable, include the following installation data for each type used:
    - a. Nominal OD.
    - b. Minimum bending radius.
    - c. Maximum pulling tension.
- B. Shop Drawings:
  - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
  - 2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
  - 3. Cabling administration drawings and printouts.
  - 4. Wiring diagrams to show typical wiring schematics, including the following:
    - a. Cross-connects.
    - b. Patch panels.
    - c. Patch cords.
  - 5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
- C. Samples: For workstation outlets, jacks, jack assemblies, in specified finish, one for each size and outlet configuration.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.
- B. Source quality-control reports.
- C. Field quality-control reports.

#### 1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For splices and connectors to include in maintenance manuals.
- B. 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.

#### 1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
  - 1. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings by an RCDD.

2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
  3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- B. Testing Agency Qualifications: An NRTL.
1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- C. Products: Listed, classified, and labeled as suitable for the purpose intended.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

## 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
1. Test optical fiber cables to determine the continuity of the strand end to end. Use optical fiber flashlight.
  2. Test optical fiber cables while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector; including the loss value of each. Retain test data and include the record in maintenance data.
  3. Test each pair of UTP cable for open and short circuits.

## PART 2 PRODUCTS

### 2.1 HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called a "permanent link," a term that is used in the testing protocols.
1. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
  2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
  3. Bridged taps and splices shall not be installed in the horizontal cabling.
  4. Splitters shall not be installed as part of the optical fiber cabling.
- B. A work area is approximately 100 sq. ft. (9.3 sq. m) and includes the components that extend from the telecommunications outlet/connectors to the station equipment.
- C. The maximum allowable horizontal cable length is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment or in the horizontal cross-connect.

### 2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1 when tested according to test procedures of this standard.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
  2. Smoke-Developed Index: 50 or less.
- 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. Grounding: Comply with J-STD-607-A.

## 2.3 BACKBOARDS

- A. Backboards: Plywood, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements in Section 061000 "Rough Carpentry" for plywood backing panels.

## 2.4 UTP CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Belden CDT Inc.; Electronics Division.
  2. Berk-Tek; a Nexans company.
  3. CommScope, Inc.
  4. Draka USA.
  5. Hubbell Premise Wiring
  6. Mohawk; a division of Belden CDT.
  7. OCC
  8. Superior Essex Inc.
  9. SYSTIMAX Solutions; a CommScope Inc. brand.
- B. Description: 100-ohm, four-pair UTP, covered with a blue thermoplastic jacket.
1. Comply with ICEA S-90-661 for mechanical properties.
  2. Comply with TIA/EIA-568-B.1 for performance specifications.
  3. Comply with TIA/EIA-568-B.2, Category 6.
  4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
    - a. Communications, General Purpose: Type CM or CMG.
    - b. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
    - c. Communications, Riser Rated: Type CMR, complying with UL 1666.
    - d. Communications, Limited Purpose: Type CMX.
    - e. Multipurpose: Type MP or MPG.
    - f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
    - g. Multipurpose, Riser Rated: Type MPR, complying with UL 1666.

## 2.5 UTP CABLE HARDWARE

- A. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

- B. Connecting Blocks: 110-style IDC for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.
- C. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
  - 1. Number of Terminals per Field: One] for each conductor in assigned cables.
- D. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
  - 1. Number of Jacks per Field: One for each four-pair UTP cable indicated.
- E. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.
- F. Patch Cords: Factory-made, four-pair cables in 36-inch (900 mm) lengths; terminated with eight-position modular plug at each end.
  - 1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.
  - 2. Patch cords shall have color-coded boots for circuit identification.

## 2.6 TELECOMMUNICATIONS OUTLET/CONNECTORS

- A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-B.1.
- B. Workstation Outlets: Two-port-connector assemblies mounted in single faceplate.
  - 1. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices."
  - 2. Metal Faceplate: Stainless steel, complying with requirements in Section 262726 "Wiring Devices."
  - 3. For use with snap-in jacks accommodating any combination of UTP, optical fiber, and coaxial work area cords.
    - a. Flush mounting jacks, positioning the cord at a 45-degree angle.
  - 4. Legend: Factory labeled by silk-screening or engraving for stainless steel.
  - 5. Legend: Machine printed, in the field, using adhesive-tape label.
  - 6. Legend: Snap-in, clear-label covers and machine-printed paper inserts.

## 2.7 GROUNDING

- A. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.
- B. Comply with J-STD-607-A.

## 2.8 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Comply with requirements in Section 260553 "Identification for Electrical Systems."

## 2.9 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to evaluate cables.
- B. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.
- C. Factory test UTP cables according to TIA/EIA-568-B.2.
- D. Factory test multimode optical fiber cables according to TIA-526-14-A and TIA/EIA-568-B.3.
- E. Factory-sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.
- F. Cable will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.

## PART 3 EXECUTION

### 3.1 ENTRANCE FACILITIES

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

### 3.2 WIRING METHODS

- A. Install cables in pathways and cable trays except within consoles, cabinets, desks, and counters. Conceal pathways and cables except in unfinished spaces.
  - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
  - 2. Comply with requirements in Section 270528 "Pathways for Communications Systems."
  - 3. Comply with requirements in Section 270536 "Cable Trays for Communications Systems."
- B. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures:
  - 1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
  - 2. Install lacing bars and distribution spools.
  - 3. Install conductors parallel with or at right angles to sides and back of enclosure.

### 3.3 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
  - 1. Comply with TIA/EIA-568-B.1.
  - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
  - 3. Install 110-style IDC termination hardware unless otherwise indicated.
  - 4. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:
    - a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.



- b. Locate consolidation points for UTP at least 49 feet (15 m) from communications equipment room.
  5. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
  6. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
  7. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
  8. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
  9. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
  10. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
  11. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
  12. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- C. UTP Cable Installation:
1. Comply with TIA/EIA-568-B.2.
  2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.
- D. Optical Fiber Cable Installation:
1. Comply with TIA/EIA-568-B.3.
  2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.
- E. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
  2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1524 mm) apart.
  3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- F. Installation of Cable Routed Exposed under Raised Floors:
1. Install plenum-rated cable only.
  2. Install cabling after the flooring system has been installed in raised floor areas.
  3. Coil cable 6 feet (1800 mm) long not less than 12 inches (300 mm) in diameter below each feed point.
- G. Outdoor Coaxial Cable Installation:
1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed O-rings to keep out moisture.

2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches (915 mm).
- H. Group connecting hardware for cables into separate logical fields.
- I. Separation from EMI Sources:
1. Comply with BICSI TDMM and TIA-569-B for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
  2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
    - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
    - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
    - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).
  3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
    - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
    - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
    - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
  4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
    - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
    - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
    - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
  5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
  6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

### 3.4 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-B, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

### 3.5 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with J-STD-607-A.

- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

### 3.6 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
  - 1. Administration Class: 1.
  - 2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.
- B. Using cable management system software specified in Part 2, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable and label cable, jacks, connectors, and terminals to which it connects with same designation. At completion, cable and asset management software shall reflect as-built conditions.
- C. Comply with requirements in Section 099123 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- D. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration.
- E. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.
- G. Cable and Wire Identification:
  - 1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
  - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
  - 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
  - 4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
    - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
    - b. Label each unit and field within distribution racks and frames.

5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
  6. Uniquely identify and label work area cables extending from the MUTOA to the work area. These cables may not exceed the length stated on the MUTOA label.
- H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.
1. Cables use flexible vinyl or polyester that flex as cables are bent.

### 3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections:
1. Visually inspect UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
  2. Visually confirm Category 5e, marking of outlets, cover plates, outlet/connectors, and patch panels.
  3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
  4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
    - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
  5. Optical Fiber Cable Tests:
    - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
    - b. Link End-to-End Attenuation Tests:
      - 1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA-526-14-A, Method B, One Reference Jumper.
      - 2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.

6. UTP Performance Tests:
  - a. Test for each outlet and MUTOA. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.2:
    - 1) Wire map.
    - 2) Length (physical vs. electrical, and length requirements).
    - 3) Insertion loss.
    - 4) Near-end crosstalk (NEXT) loss.
    - 5) Power sum near-end crosstalk (PSNEXT) loss.
    - 6) Equal-level far-end crosstalk (ELFEXT).
    - 7) Power sum equal-level far-end crosstalk (PSELFEXT).
    - 8) Return loss.
    - 9) Propagation delay.
    - 10) Delay skew.
7. Optical Fiber Cable Performance Tests: Perform optical fiber end-to-end link tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.3.
8. Coaxial Cable Tests: Conduct tests according to Section 274133 "Master Antenna Television System."
9. Final Verification Tests: Perform verification tests for UTP systems after the complete communications cabling and workstation outlet/connectors are installed.
  - a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.
  - b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.
- D. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

**END OF SECTION 271500**

SECTION 28 05 13  
CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

**PART 1 GENERAL**

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

- A. Section Includes:
  - 1. Low-voltage control cabling.
  - 2. Control-circuit conductors.
  - 3. Fire alarm wire and cable.
  - 4. Identification products.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.
- B. Source quality-control reports.
- C. Field quality-control reports.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.

1.6 FIELD CONDITIONS

- A. Do not install conductors and cables that are wet, moisture damaged, or mold damaged.
  - 1. Indications that wire and cables are wet or moisture damaged include, but are not limited to, discoloration and sagging of factory packing materials.
- B. Environmental Limitations: Do not deliver or install UTP, optical fiber, and coaxial cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

**PART 2 PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 50 or less.

- 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.

## 2.2 LOW-VOLTAGE CONTROL CABLE

- A. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.
  - 1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors.
  - 2. PVC insulation.
  - 3. Unshielded.
  - 4. PVC jacket.
  - 5. Flame Resistance: Comply with NFPA 262.

## 2.3 CONTROL-CIRCUIT CONDUCTORS

- A. Class 1 Control Circuits: Stranded copper, Type THHN-THWN, complying with UL 83, in raceway.
- B. Class 2 Control Circuits: Stranded copper, Type THHN-THWN, complying with UL 83, in raceway.
- C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or TF, complying with UL 83.

## 2.4 FIRE ALARM WIRE AND CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Belden
  - 2. Draka Cableteq USA.
  - 3. General Cable - Carol Brand.
  - 4. Genesis Cable Products; Honeywell International, Inc.
  - 5. Rockbestos-Suprenant Cable Corp.
  - 6. West Penn.
- B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.
- C. Signaling Line Circuits: Twisted, shielded pair, No. 18 AWG.
- D. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.
  - 1. Line-Voltage Circuits: No. 12 AWG, minimum.
  - 2. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with red identifier stripe, NRTL listed for fire alarm and cable tray installation, plenum rated, and complying with requirements in UL 2196 for a 2-hour rating.

## 2.5 IDENTIFICATION PRODUCTS

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."

## 2.6 SOURCE QUALITY CONTROL

- A. Cable will be considered defective if it does not pass tests and inspections.

- B. Prepare test and inspection reports.

### **PART 3 EXECUTION**

#### **3.1 INSTALLATION OF HANGERS AND SUPPORTS**

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for installation of supports for cables.

#### **3.2 WIRING METHOD**

- A. Install wiring in metal pathways and wireways.
  - 1. Minimum conduit size shall be 3/4 inch (21 mm). Control and data transmission wiring shall not share conduit with other building wiring systems.
- B. Install cable, concealed in accessible ceilings, walls, and floors when possible.
- C. Wiring within Enclosures:
  - 1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
  - 2. Install lacing bars and distribution spools.
  - 3. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer.
  - 4. Install conductors parallel with or at right angles to sides and back of enclosure.
  - 5. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with intrusion system to terminal blocks.
  - 6. Mark each terminal according to system's wiring diagrams.
  - 7. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

#### **3.3 INSTALLATION OF CONDUCTORS AND CABLES**

- A. Comply with NECA 1.
- B. Conductors: Size according to system manufacturer's written instructions unless otherwise indicated.
- C. General Requirements for Cabling:
  - 1. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
  - 2. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
  - 3. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
  - 4. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
  - 5. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.



### 3.4 FIRE ALARM WIRING INSTALLATION

- A. Comply with NECA 1 and NFPA 72.
- B. Wiring Method: Install wiring in metal raceway according to Section 28 0528 "Pathways for Electronic Safety and Security."
  - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
- C. Wiring Method:
  - 1. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
  - 2. Signaling Line Circuits: Power-limited fire alarm cables shall not be installed in the same cable or raceway as signaling line circuits.
- D. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- E. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.
- F. Wiring to Remote Alarm Transmitting Device: 1-inch (25-mm) conduit between the fire alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

### 3.5 POWER AND CONTROL-CIRCUIT CONDUCTORS

- A. 120-V Power Wiring: Install according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables" unless otherwise indicated.
- B. Minimum Conductor Sizes:

### 3.6 CONNECTIONS

- A. Comply with requirements in Section 283111 "Digital, Addressable Fire-Alarm System for connecting, terminating, and identifying wires and cables.

### 3.7 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."

### 3.8 GROUNDING

- A. For low-voltage wiring and cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

### 3.9 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### 3.10 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
- B. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
- C. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

**END OF SECTION 280513**

SECTION 28 05 28  
PATHWAYS FOR ELECTRONIC SAFETY AND SECURITY

**PART 1 GENERAL**

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
  - 1. Metal conduits, tubing, and fittings.
  - 2. Boxes, enclosures, and cabinets.

1.3 ACTION SUBMITTALS

- A. Product Data: For surface pathways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

**PART 2 PRODUCTS**

2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. General Requirements for Metal Conduits and Fittings:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. GRC: Comply with ANSI C80.1 and UL 6.
- C. IMC: Comply with ANSI C80.6 and UL 1242.
- D. EMT: Comply with ANSI C80.3 and UL 797.
- E. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- F. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
  - 1. Fittings for EMT:
    - a. Material: Steel or die cast.
    - b. Type: Setscrew or compression.
  - 2. Expansion Fittings: PVC or steel to match conduit type, complying with UL 467, rated for environmental conditions where installed, and including flexible external bonding jumper.

- G. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

## 2.2 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
- B. General Requirements for Boxes, Enclosures, and Cabinets:
  - 1. Boxes, enclosures and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet-Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- E. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- G. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- H. Device Box Dimensions: 4-inches square by 2-1/8 inches deep (100 mm square by 60 mm deep).
- I. Gangable boxes are prohibited.
- J. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
  - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
  - 2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- K. Cabinets:
  - 1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
  - 2. Hinged door in front cover with flush latch and concealed hinge.
  - 3. Key latch to match panelboards.
  - 4. Metal barriers to separate wiring of different systems and voltage.
  - 5. Accessory feet where required for freestanding equipment.

## PART 3 EXECUTION

### 3.1 PATHWAY APPLICATION

- A. Outdoors: Apply pathway products as specified below unless otherwise indicated:
  - 1. Exposed Conduit: GRC.
  - 2. Concealed Conduit, Aboveground: IMC.
  - 3. Underground Conduit: RNC, Type EPC-80-PVC, direct buried.
  - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
  - 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

- B. Indoors: Apply pathway products as specified below unless otherwise indicated:
  - 1. Exposed, Not Subject to Physical Damage: EMT.
  - 2. Exposed, Not Subject to Severe Physical Damage: EMT.
  - 3. Exposed and Subject to Severe Physical Damage: GRC. Pathway locations include the following:
    - a. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    - b. Mechanical rooms.
  - 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
  - 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric-Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
  - 6. Damp or Wet Locations: GRC.
  - 7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Pathway Size Indoor: 3/4-inch (21-mm) trade size. Minimum size for optical-fiber cables is 1 inch (27 mm).
- D. Minimum Pathway Size Outdoor: 1-inch (27-mm) trade size. Minimum size for optical-fiber cables is 1 inch (27 mm).
- E. Pathway Fittings: Compatible with pathways and suitable for use and location.
  - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
  - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
  - 3. EMT: Use setscrew or compression, cast-metal fittings. Comply with NEMA FB 2.10.
  - 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

### 3.2 INSTALLATION

- A. Comply with NECA 1, NECA 101, and TIA-569-B for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum pathways. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.
- B. Keep pathways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.
- C. Complete pathway installation before starting conductor installation.
- D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications wiring conduits for which only two 90-degree bends are allowed. Support within 12 inches (300 mm) of changes in direction.

- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches (300 mm) of enclosures to which attached.
- I. Stub-ups to Above Accessible Ceilings:
  - 1. Use EMT, IMC, or RMC for pathways.
  - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- J. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.
- K. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.
- L. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- M. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to conduit assembly to assure a continuous ground path.
- N. Cut conduit perpendicular to the length. For conduits of 2-inch (53-mm) trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.
- O. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground pathways designated as spare above grade alongside pathways in use.
- P. Install pathway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway sealing fittings according to NFPA 70.
- Q. Install devices to seal pathway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:
  - 1. Where an underground service pathway enters a building or structure.
  - 2. Where otherwise required by NFPA 70.
- R. Flexible Conduit Connections: Comply with NEMA RV 3. Use maximum of 72 inches (1830 mm) of flexible conduit for 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.
- S. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- T. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- U. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- V. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

- W. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

### 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 Section 312000 "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.
2. Install backfill as specified in Section 312000 "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 (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
  - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling.
  - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
6. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

### 3.4 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRONIC SAFETY AND SECURITY PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 280544 "Sleeves and Sleeve Seals for Electronic Safety and Security Pathways and Cabling."

### 3.5 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

### 3.6 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
  1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

**END OF SECTION 280528**

SECTION 28 05 44  
SLEEVES AND SLEEVE SEALS FOR ELECTRONIC SAFETY AND SECURITY PATHWAYS AND  
CABLING

**PART 1 GENERAL**

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
  - 1. Sleeves for pathway and cable penetration of non-fire-rated construction walls and floors.
  - 2. Sleeve-seal systems.
  - 3. Sleeve-seal fittings.
  - 4. Grout.
  - 5. Silicone sealants.
- B. Related Requirements:
  - 1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

**PART 2 PRODUCTS**

2.1 SLEEVES

- A. Wall Sleeves:
  - 1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.
- C. Sleeves for Rectangular Openings:
  - 1. Material: Galvanized-steel sheet.
  - 2. Minimum Metal Thickness:
    - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).



- b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

## 2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.
  - 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: Carbon steel.
  - 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

## 2.3 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

## 2.4 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## 2.5 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
  - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
  - 2. Sealant shall have VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Silicone Foams: Multicomponent, silicone-based, liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

## PART 3 EXECUTION

### 3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
  - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

- a. Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
  - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
- 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
  - 3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pathway or cable unless sleeve seal is to be installed.
  - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
  - 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level. Install sleeves during erection of floors.
- C. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
- 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
  - 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

### 3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at pathway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### 3.3 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

**END OF SECTION 280544**

SECTION 28 31 11  
DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

**PART 1 GENERAL**

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract 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. Heat detectors.
  5. Notification appliances.
  6. Remote annunciator.
  7. Addressable interface device.
  8. 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 automatic sensitivity control of certain smoke detectors and multiplexed signal transmission, dedicated to fire-alarm service only.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. 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.

C. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
2. Shop Drawings shall be prepared under the supervision of persons with the following qualifications:
  - a. NICET-certified fire-alarm technician, Level IV minimum.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," 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.
- B. 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.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project. Firm with minimum 3 years documented experience installing fire alarm systems of the specified type and providing contract maintenance service as a regular part of their business.
- B. Designer Qualifications: NICET Level III or IV (3 or 4) certified fire alarm technician or registered fire protection engineer, employed by fire alarm control panel manufacturer, Contractor, or installer, with experience designing fire alarm systems in the jurisdictional area of the authorities having jurisdiction.

- C. 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.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.
- F. NFPA Certification: Obtain certification according to NFPA 72 by an NRTL.

#### 1.9 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.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers:
  - 1. Siemens Building Technologies, Inc.; Fire Safety Division. - No substitutions

#### 2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices:
  - 1. Manual stations.
  - 2. Duct smoke detectors.
  - 3. Automatic sprinkler system water flow.
- B. Fire-alarm signal shall initiate the following actions:
  - 1. Continuously operate alarm notification appliances.
  - 2. Identify alarm at fire-alarm control unit and remote annunciators.
  - 3. Transmit an alarm signal to the remote alarm receiving station.
  - 4. Activate voice/alarm communication system.
  - 5. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
  - 6. 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: annunciate at fire-alarm control unit and remote annunciators. Record the event in system memory.
- F. System Trouble and Supervisory Signals Actions: annunciate at fire-alarm control unit and remote-control units. Record the event in system memory.

### 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.
  2. Addressable initiation devices that communicate device identity and status.
- 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, 3 line(s) of 80 characters, minimum.
  2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.
- C. Circuits:
1. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class A.
    - a. Initiating Device Circuits: Style D.
    - b. Notification Appliance Circuits: Style Z.
    - c. Signaling Line Circuits: Style 2.
    - d. Install no more than 50 addressable devices on each signaling line circuit.
- D. Notification Appliance Circuit: Operation shall sound in a temporal pattern.
- E. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.

- F. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.
- G. 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 signals shall be powered by 24-V dc source.
- H. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
  - 1. Batteries: Sealed lead calcium.
- I. 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 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
  - 1. Double-action mechanism requiring two actions to initiate an alarm, breaking-glass or plastic-rod type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
  - 2. Station Reset: Key- or wrench-operated switch.

## 2.5 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 four-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 indicating 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. Provide multiple levels of detection sensitivity for each sensor.
- B. Photoelectric Smoke Detectors:
  - 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. 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.
  - 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.

## 2.6 HEAT DETECTORS

- A. General Requirements for Heat Detectors: Comply with UL 521.
- B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or a rate of rise that exceeds 15 deg F (8 deg C) per minute unless otherwise indicated.
  - 1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
- C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F (88 deg C).
  - 1. Mounting: Twist-lock base interchangeable with smoke-detector bases.

## 2.7 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Individually addressed, connected to a signaling line circuit, 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 (3 m) 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- (25-mm-) 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.
- D. Voice/Tone Notification Appliances:
  - 1. Appliances shall comply with UL 1480 and shall be listed and labeled by an NRTL.



2. High-Range Units: Rated 2 to 15 W.
3. Low-Range Units: Rated 1 to 2 W.
4. Mounting: Flush.
5. Matching Transformers: Tap range matched to acoustical environment of speaker location.

## 2.8 REMOTE ANNUNCIATOR

- A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
  1. Mounting: Flush cabinet, NEMA 250, Type 1.
- B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

## 2.9 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.

## 2.10 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 one 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 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.
- D. Digital data transmission shall include the following:
  1. Address of the alarm-initiating device.
  2. Address of the supervisory signal.
  3. Address of the trouble-initiating device.
  4. Loss of ac supply or loss of power.
  5. 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.

## 2.11 DEVICE GUARDS

- A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.
  - 1. Factory fabricated and furnished by manufacturer of device.
  - 2. Finish: Paint of color to match the protected device.

## 2.12 DOCUMENTATION CABINET

- A. Documentation cabinet: Steel with baked enamel finish, size appropriate to contain all necessary documentation. cabinet shall be lockable and accessible by authorized personnel only. Labeled System Record Documents

## PART 3 EXECUTION

### 3.1 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72 for installation of fire-alarm equipment.
- B. Equipment Mounting: Install fire-alarm control unit on concrete base with tops of cabinets not more than 72 inches (1830 mm) above the finished floor. Comply with requirements for concrete base specified in Section 03 3000 "Cast-in-Place Concrete."
  - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
  - 2. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 3. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Smoke- or Heat-Detector Spacing:
  - 1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
  - 2. Smooth ceiling spacing shall not exceed 30 feet (9 m).
  - 3. HVAC: Locate detectors not closer than 3 feet (1 m) from air-supply diffuser or return-air opening.
  - 4. Lighting Fixtures: Locate detectors not closer than 12 inches (300 mm) from any part of a lighting fixture.
- D. Duct Smoke Detectors: Comply with NFPA 72 and IMC. Install sampling tubes so they extend the full width of duct.
- E. 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.
- F. Audible Alarm-Indicating Devices: Install not less than 6 inches (150 mm) below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.
- G. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches (150 mm) below the ceiling.
- H. Device Location-Indicating Lights: Locate in public space near the device they monitor.
- I. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.

- J. Annunciator: Install with top of panel not more than 72 inches (1830 mm) above the finished floor.
- K. Documentation cabinet:
  - 1. installed at fire alarm panel or another approved location at the protected premises.
  - 2. all record documentation shall be stored in the documentation cabinet.
  - 3. no record documentation shall be stored in the control unit
  - 4. when not at control unit indicate location of documentation cabinet at the control unit.
  - 5. Emergency communication system and fire alarm system record documentation shall be permitted to be maintained together in the same cabinet

### 3.2 CONNECTIONS

- A. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet (1 m) 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.

### 3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Install framed instructions in a location visible from fire-alarm control unit.

### 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. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections:
  - 1. 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.
  - 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.
- E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
  - F. Fire-alarm system will be considered defective if it does not pass tests and inspections.
  - G. Prepare test and inspection reports.
- 3.6 DEMONSTRATION
- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

**END OF SECTION**

SECTION 31 23 10  
STRUCTURE EXCAVATION AND BACKFILL

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Provide labor, materials, equipment, and supervision necessary to complete the following:
  - 1. Excavate for structure and remove subsoil from site.
  - 2. Cap off and seal discontinued utility services and remove portions of lines within excavated areas.
  - 3. Shore and brace excavations as required.
  - 4. Place and compact fills to rough grade elevations.
  - 5. Dewater excavations.
  - 6. Excavate and backfill at piping inside existing building.

1.2 SITE COMPACTION TESTING

- A. The Owner will engage and pay for the services of a testing agency to provide testing of compacted materials. Testing will be performed so as to least encumber the performance of work. The independent testing agency shall provide qualified inspectors to perform field testing and inspections of the work in this section to the extent required in accordance with Chapter 17 of the 2021 International Building Code. Refer to S001 Statement of Special Inspections for additional information.
- B. When work of this Section or portions of work are completed, notify the testing laboratory to perform density tests. Do not proceed with additional portions of work until results have been verified.
- C. If, during progress of work, tests indicated that compacted materials do not meet specified requirements, remove defective work, replace and retest at no cost to Owner.
- D. Ensure compacted fills are tested before proceeding with placement of surface materials.

1.3 SUBMITTALS

- A. Submit test results for fill materials to be used to the testing laboratory. Such test results are to clearly indicate types of materials and composition, hardness, compactability, and suitability for proposed usage.

1.4 PROTECTION

- A. Protect trees, shrubs and lawns, areas to receive planting, rock outcropping, and other features remaining as part of final landscaping.
- B. Protect benchmarks and existing structures, roads, sidewalks, paving, and curbs against damage from equipment and vehicular or foot traffic.
- C. Protect excavations by shoring, bracing, sheet piling, underpinning, or other methods, as required to prevent cave-ins or loose dirt from falling into excavations.
- D. Underpin adjacent structure(s) which may be damaged by excavation work, including service lines and pipe chases.
- E. Notify Architect/Engineer of unexpected subsurface conditions and discontinue work in area until Architect/Engineer provides notification to resume work.

- F. Grade around excavations to prevent surface water runoff into excavated areas.

## **PART 2 PRODUCTS**

### **2.1 FILL MATERIALS**

#### **A. Granular Fill**

1. Well Graded: Iowa DOT Gradation 4120.04 - Class A road stone, or other aggregate with at least 18% passing the U.S. No. 200 sieve.
2. Free Draining: Iowa DOT Gradation 12a, Section 4121 or other aggregate with less than 6 percent passing the U.S. No. 200 sieve.
3. Architect/Engineer approved gravel or sand from a local source. Provide submittal for each.

#### **B. Structural Fill**

1. Any materials acceptable as granular fill per paragraph 2.1.A.
2. New fill may be inorganic cohesive soil with a liquid limit less than 45, a maximum plasticity index of 23, and free of organic matter, frozen materials and debris. Engineer to approve fill prior to placement.
3. Moderate to high plasticity (lean to fat clay) soils are not acceptable.
4. Fills that contain debris, roots, organic matter, frozen matter, and stone with any dimension greater than ½ the loose layer thickness are not acceptable.
5. Architect/Engineer approved fill from a local source. Provide submittal.

#### **C. Subsoil: Excavated or off-site materials free from roots, broken concrete, broken asphalt, rocks larger than three inches (75mm) in size, and building debris.**

#### **D. Fill Under Landscaped Areas: Free from alkali, salt, and petroleum products. Use subsoil excavated from site only if conforming to specified requirements.**

### **2.2 VAPOR BARRIER**

- A. 15 mil Stego Wrap by Stego Industries or pre-approved substitute.

## **PART 3 EXECUTION**

### **3.1 PREPARATION AND LAYOUT**

- A. Establish extent of excavation by area and elevation; designate and identify datum elevation.
- B. Set required lines and levels.
- C. Maintain benchmarks, monuments, and other referenced points.

### **3.2 UTILITIES**

- A. Before starting excavation, establish location and extent of underground utilities occurring in work area.
- B. Notify utility companies to remove and relocate lines that are in the way of excavation.
- C. Maintain, reroute, or extend as required, existing utility lines to remain which pass through work area.
- D. Pay costs for this work, except those covered by utility companies.

- E. Protect utility services uncovered by excavation.
- F. Remove abandoned utility service lines from areas of excavation; cap, plug, or seal such lines and identify at grade.
- G. It is the contractor's responsibility to accurately locate and record abandoned and active utility lines, rerouted or extended, on Project Record Documents.

### 3.3 EXISTING CONDITIONS

- A. A soils investigation was conducted by Terracon Consultants, Inc. and a report was submitted on May 2, 2023, Project No. 08225393-01. This soils investigation is included in the specification.
- B. Footings: New structures bearing on new foundations are designed for a net bearing capacity of 1500 psf bearing on undisturbed, native soils per the documents and geotechnical report. Owner's independent testing agent shall verify that bearing on structural backfill or existing soils at existing footing extensions meets or exceeds assumed bearing capacity.
- C. Building Pad: At all building and stage slabs on grade, 24 inches of properly compacted Well Graded Granular Fill or Structural Fill shall be provided directly below the stabilizing base course under the floor slabs. Where grade is not being built up 24", overexcavation and backfill of native material will be required. Above the 24" compacted zone, a minimum of 6" Free Draining Granular Fill stabilizing base course shall be placed per Paragraph 3.6C in this specification.

### 3.4 EXCAVATION

- A. Excavate subsoil in accordance with lines and levels required for construction of the work, including space for forms, bracing and shoring, foundation drainage system, applying dampproofing, and to permit inspection.
- B. Do additional excavation only by written authorization of Architect/Engineer.
- C. Machine slope banks.
- D. Hand trim excavations and leave free from loose or organic matter.
- E. When complete, verify soil bearing capacities, depths, and dimensions.
- F. Correct unauthorized excavation as directed, at no cost to the Owner.
- G. Fill over excavated areas under structure bearing surfaces with backfill as specified for foundations.
- H. Excavations are not to interfere with normal 45 degree bearing splay of any foundation.
- I. Remove excavated material from building site to Owner specified location North in Owner Training Range.
- J. Removal of boulders or buried rock in excess of 1/2 cubic yard (.4m<sup>3</sup>) may be authorized as an extra; other work is deemed to be within the scope of this section.
- K. Do not disturb soil within drip line of existing trees or shrubs that are to remain.
- L. If necessary to excavate through roots, perform work by hand and cut roots with a sharp ax.

### 3.5 BACKFILLING

- A. Do not backfill over existing subgrade surfaces that are porous, wet, or spongy.
- B. Compact existing subgrade surfaces if densities are not equivalent to that required for backfill materials.
- C. Cut out soft areas of existing subgrade. Backfill with sand and compact to required density.

- D. Backfill areas to grades, contours, levels, and elevations.
- E. Backfill systematically and as early as possible to allow maximum time for natural settlement and compaction.
- F. Backfill shall not be placed adjacent to concrete structures until the concrete has achieved at least 75% of its design strength.
- G. Place and compact fill materials in continuous layers not exceeding six inches (150mm) loose depth. Use a method so as not to disturb or damage foundation dampproofing.
- H. Maintain optimum moisture content of backfill materials to attain required compaction density.
- I. Backfill simultaneously on each side of foundation walls to equalize soil pressures.
- J. Where temporary unbalanced pressures are liable to develop on walls before floor slabs are placed, erect necessary shoring to counteract imbalance.

### 3.6 FILL TYPES AND COMPACTION

- A. Below footings: Structural fill to top of subgrade elevation. Compact to 98% of maximum Standard Proctor Density per ASTM D698 at frequency of one test per 100 square yards.
- B. Above foundations and below floor slabs: Compact to 95% of maximum Standard Proctor Density per ASTM D698 at frequency of one test per 100 square yards.
- C. Stabilizing base course under concrete slabs within building area:
  - 1. Six inches of compacted free draining well graded crushed stone containing less than 6% passing the No. 200 sieve. Compact to at least 95% of ASTM D698. Overtop the crushed stone with a vapor barrier.
- D. Fill under landscaped areas: Subsoil to top of subgrade elevation. Compact to 90% of maximum Standard Proctor Density per ASTM D698 at frequency of one test per 500 square yards.

**END OF SECTION**



SECTION 31 23 16  
OVER EXCAVATION AND BACKFILL FOR UNSUITABLE MATERIAL

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Removal of unsuitable materials from the work area and replacing with compacted stone. Unsuitable materials include, but are not limited to:
  - 1. Areas indicated to be over excavated and backfilled on plans.
  - 2. Rubbish or other items uncovered in the excavation.
  - 3. Any material which the Owner's Representative deems unsuitable for the proposed construction.

**PART 2 PRODUCTS**

2.1 MATERIALS

- A. Backfill for over excavated areas: Clean crushed stone meeting following gradation:

| Sieve Size | Percent Passing |
|------------|-----------------|
| 3" (75mm)  | 100%            |
| 1" (25mm)  | 25 - 95%        |

- B. Structural fill per Section 31 2310, Paragraph 2.1 B allowed for items 1.1.A.2 and 1.1.A.3 only.

**PART 3 EXECUTION**

3.1 EXCAVATION

- A. Remove and dispose of unsuitable material to neat lines as directed by the Owner's Representative.

3.2 BACKFILL

- A. Deposit backfill material in layers not exceeding six inches compacted thickness.
- B. Compact each layer to 95% of maximum Standard Proctor Density per ASTM D698 unless beneath footing. Beneath footing compact each layer to 98% of maximum Standard Proctor Density per ASTM D698. Frequency of one test per 100 square yards.

**END OF SECTION**