



# **DPW ADMIN BUILDING**

**CONTRACT 2024-10G**

**2024-10P**

**2024-10M**

**2024-10E**

**Prepared by:**  
**The City of Rye Engineering Department**  
**1051 Boston Post Road**  
**Rye, NY 10580**

**City Engineer: Ryan Coyne, PE**  
**Telephone: (914) 967-7676**

**September 12, 2024**

## **NOTICE**

**The following pages of this Proposal must be completed in their entirety. Failure to do so may result in an irregular bid:**

- **Pages 7 through 13 (Proposal Summary, Bid Sheets, and Bidder's Proposal)**
- **Pages 15 through 18 (Non-Collusive Affidavit and Vendor Conflict of Interest Questionnaire)**

**Bidders are directed to print this document and submit a bound copy with all required information completed in a sealed envelope addressed to The City Clerk, City of Rye, 1051 Boston Post Road, Rye, NY 10580 and have the words**

**“Contract #2024-10G DPW ADMIN BUILDING” clearly marked on the outside of the envelope or Contract #2024-10P, or #2024-10M, or #2024-10E.**

**The Bidder shall take notice that this contract is subject to New York State Prevailing Wage Rates. Certified Payrolls shall be submitted with monthly invoices for payment as per the NYS Department of Labor.**

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(CONTRACT LEGAL DOCUMENTS)

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## PUBLIC NOTICE REVISED

City of Rye  
New York

NOTICE IS HEREBY GIVEN that sealed bids for **DPW ADMIN BUILDING PROJECT**, will be received by the City of Rye on **November 6, 2024 until 10:00 AM** at the office of the City Clerk at which time and place will be opened and read aloud by the Clerk for the work:

<b>GENERAL CONSTRUCTION</b>	<b>CONTRACT NO. 2024-10G</b>
<b>PLUMBING CONSTRUCTION</b>	<b>CONTRACT NO. 2024-10P</b>
<b>MECHANICAL CONSTRUCTION</b>	<b>CONTRACT NO. 2024-10M</b>
<b>ELECTRICAL CONSTRUCTION</b>	<b>CONTRACT NO. 2024-10E</b>

Bid Security equal to 5% of the total of each bid will be required in the form of Certified Check, Bid Bond or Bank Draft.

Plans, specifications, and other Contract Documents are available at [www.empirestatebidsystem.com](http://www.empirestatebidsystem.com) and may be obtained therefrom beginning on **September 23, 2024 at 3:00 PM**. There is no charge for the bid documents. Bid security must be made payable to the City of Rye, in the amount specified above.

Bid must be in a sealed envelope addressed to The City Clerk, City of Rye, City Hall, Rye, New York 10580 and have the words “**Contract #2024-10G DPW Admin Building Project**” clearly marked on the outside of the envelope or **Contract #2024-10P**, or **#2024-10M**, or **#2024-10E**.

No bidder may withdraw his bid within 45 days after the date bids are opened. No bid will be received or considered after the time stated herein above.

Additional Information and Technical Questions can be directed to Stantec, Michael Geary, PE emailed at [Michael.Geary@stantec.com](mailto:Michael.Geary@stantec.com).

A schedule site walk will be on Wednesday, October 2, 2024, at 10:00 am at 141 Oakland Beach Avenue, Rye, New York 10580.

The City of Rye reserves the right to reject any and all bids and to waive any informality in the bids received.

**The City’s acceptance of the lowest responsible bid is not binding until the written contract is signed by all parties. The oral award of the bid to the lowest responsible bidder is not an enforceable agreement.**

Noga Ruttenberg  
City of Rye  
City Clerk

## **SECTION I: INFORMATION FOR BIDDERS**

### **A. CONTENTS**

Attention of bidders is called to the contents of the Invitation to Bidders and Scope of the Work, a copy of which is annexed hereto and made a part hereof. All the work in this contract is described in detail in the Plans and Specifications, Information for Bidders, Bidder's Proposal and Contract Documents, all of which are attached hereto and make a part hereof.

### **B. DATE AND TIME OF FILING BIDS**

Sealed bids or proposals will be received at the office of the City Clerk, City Hall, 1051 Boston Post Road, Rye, N.Y., for the work herein mentioned, at which place and after which time they will be publicly opened and read aloud. No bid shall be received or considered after the time stated herein.

### **C. BID FORM**

Each bid must be upon the blank form for proposal attached hereto, state the proposal price for each item of work both in words and in figures, and be signed by the bidder with his business address and place of residence. In case of any discrepancy, the written prices shall be considered the prices bid.

Bidders shall not remove or submit the proposal pages separately from the volume of contract documents, but shall submit their proposals bound in with the complete volume of documents, including all pages, correctly assembled.

All bids must be submitted in a sealed envelop endorsed with the name of the work and the contract number, and the name of the person making the same.

Before submitting a proposal, bidders shall carefully read the specifications and other contract documents, shall visit the site, and shall fully inform themselves as to all existing conditions and limitations, and shall include in the proposal a sum to cover the cost of all items included in the Contract Drawings and Documents.

### **D. INFORMAL BIDS**

The City Council of the City of Rye may reject, as informal, bids which are incomplete, conditional, or obscure, or which contain additions not called for, erasures, alterations, or irregularities of any kind, or the City Council may waive any such informality they may deem immaterial or non-prejudicial to the City and other bidders.

The City Council reserves the right to select the bid or proposal the acceptance of which will, in their judgment, best secure the sufficient performance of the work or to reject any or all bids.

**E. ACCEPTANCE OF BIDS**

No bid will be allowed to be withdrawn for any reason whatever after it has been deposited with the City Clerk. No bid will be accepted from, or contract awarded to, any person who is in arrears to the City of Rye, upon debt or contract, nor who is in default, as surety or otherwise, upon any obligation to the City of Rye.

**F. BID SECURITY**

Each bid must be accompanied by a certified check, cashier's check, or bid bond. Certified or cashier's checks shall be made payable to the City of Rye, New York for the amount stated in the INVITATION TO BIDDERS. Bid bonds must be issued by an approved bonding or insurance company, authorized to do business within the State of New York. Such security shall be in the amount of not less than five per cent (5%) of the proposal submitted.

All bid deposits, whether check or bond shall be held by the City of Rye, New York, as security that the person or persons to whom the contract shall be awarded will enter into a contract therefor and give security for the performance thereof within ten (10) days after notice of such award. Such bid deposit must be enclosed in the sealed envelope containing the bid.

All bid deposits will be returned to all except the three (3) lowest bidders with in four (4) business days after the formal opening of the bid. The bid deposits will be returned to the three (3) lowest bidders with three (3) business days after the City and the accepted bidder have executed the contract, or, if no contract has been so executed, within forty-five (45) days after the opening of the bids, upon demand of the bidder at any time thereafter so long as he has not been notified of the acceptance of his bid.

If the bidder to whom the contract shall be haven been awarded shall refuse or neglect to execute and deliver the same and furnish the security required with ten (10) days after due notice that the contract has been awarded to him, the amount of the bid deposit made by him shall be retained by the City of Rye as liquidated damages for such neglect or refusal, and shall be paid into the General Fund of the City of Rye; but if the said bidder to whom the contract is awarded shall execute and deliver the contract and furnish the said security within the time specified, the amount of the bid deposit will be returned to him.

The bidder by submission of his bid agrees with the City of Rye that the amount of said bid deposit represents the minimum amount of the damages the City will suffer by reason of any default as aforesaid.

## **G. ATTENTION DIRECTED**

The attention of bidders is directed to those provisions of the Contract Agreement relative to:

- Compliance with laws
- Labor conditions
- Wage rates
- Insurance required

## **H. BIDDERS TO INVESTIGATE**

Bidders are required to submit their Proposals upon the following express conditions, which shall apply to and become part of every bid received:

Bidders must satisfy themselves by personal examination of the location of the proposed work and by such other means as they may desire as to actual conditions and requirements of the work.

## **I. QUESTIONS REGARDING CONTRACT DOCUMENTS**

In general, no answer will be given in reply to an oral question, of the question involves an interpretation of the intent or meaning of the plans or contract documents or the equality of use of products or methods other than those definitely designated or described in the specifications. All information given to bidders other than by means of the plans or contract documents or by Addenda as described below, is given informally and shall not be used as the basis of a claim against the City of Rye or the City Engineer.

To receive consideration, such question shall be submitted in writing to the City Engineer at least twelve (12) calendar days before the established date for receipt of bids.

The City Engineer will arrange as Addenda, which shall become a part of the contract, all questions received as above provided, with his decision regarding each. At least three (3) calendar days prior to the receipt of bids, he will send a copy of these Addenda to each of those who have taken out the contract documents.

## **J. TIME FOR COMPLETION**

It is the purpose of the City Engineer to build the works under his charge in the shortest time consistent with good construction. A complete and well designed construction plan and effective organization will be insisted upon. The attention of prospective bidders is especially directed to the contract requirements as to the time of beginning work, the rate of progress and the time allowed for constructing and completing the work, the rate of progress and the time allowed for constructing and completing the work, as set forth elsewhere in this contract.

**K. SCOPE OF WORK**

Project consists of the demolition of an existing DPW garage building and the construction of a new, multiuse, garage and administrative office building. Additionally, the project includes new electrical service entrance to the 141 Oakland Ave site in general, and the installation of new photovoltaic solar power systems on the new DPW building and adjacent existing buildings.

**L. SPECIAL CONDITIONS**

The single project will be undertaken under four individual prime contracts, in conformance with NYS Municipal Law

**M. ABILITY AND EXPERIENCE OF BIDDER**

It is the purpose of the City of Rye not to award this contract to any bidder who does not furnish evidence satisfactory to the City that he has ability and experience in this class of work, that he has sufficient capital and plant to enable him to prosecute the same successfully and to complete it in the time named.

The City may make such investigations as it deems necessary to determine the ability of the bidders to perform the work. Information regarding experience, financial resources, and facilities, shall be submitted in the Bidder's Proposal. The City Council reserves the right to reject any proposal if the evidence submitted by or the investigations of such bidder fails to satisfy it that such bidder is properly qualified to carry out the work contemplated under this contract.

**N. BONDS REQUIRED**

For the performance of the contract, a performance bond, and labor and materials payment bond will be required, each of which shall be in the penalty of one hundred (100) per centum of the contract price, shall be in the annexed forms, shall be signed by the party to whom the work is awarded and by a solvent fidelity or surety company authorized by the laws of this State to transact such business, and must meet with the approval of the Corporation Counsel of the City of Rye as to adequacy, form and correctness.

The bidder to whom the contract is awarded will be required to attend at the office of the City Clerk in person, or, if a corporation, shall be represented by a duly authorized representative, with the Surety offered by him and shall be prepared to execute the contract and bonds and furnish the required insurance or acceptable binders or certificates within ten (10) days after written notice from the City Clerk that the contract has been awarded to him. In case of failure or neglect to do so he may be deemed to have abandoned the contract as in default to the City under the provisions set forth above.

If at any time after the execution and approval of this contract and the performance and payment bonds required by the contract documents the City of Rye shall deem any of the sureties upon such bond to be inadequate security for the City of Rye, the Contractor, within five (5) days after notice from the City of Rye by the City Clerk to do so, shall furnish a new or additional bond, in

for, sum, and signed by such sureties, as shall be satisfactory to the City of Rye. No further payment shall be deemed due nor shall any further payment be made to the Contractor unless and until such new or additional bond shall be furnished and approved. Premiums on such bonds will be paid for by the Contractor.

**O. INSURANCE REQUIRED**

The attention of bidders is called to the fact that the Contractor shall be required to take out, and continue in effect during the life of the contract, insurance with the provisions fully set forth elsewhere in this contract, and in the amounts specified herein. If binders or certificates are accepted temporarily, bidders should note that policies must be furnished and approved before any payment will be made under a contract.

**PROPOSAL SUMMARY**  
**DPW ADMIN BUILDING**  
**CONTRACT NO. 2024-10G**

Name of Bidder: \_\_\_\_\_

Name of Contract: \_\_\_\_\_

**TOTAL BID:** \*Lump Sum Amount:

\_\_\_\_\_  
 (Written in numbers)

\_\_\_\_\_  
 (Written in words)

Bidder acknowledges receipt of Addenda as follows:

\_\_\_\_\_ Signature \_\_\_\_\_

\_\_\_\_\_ Signature \_\_\_\_\_

\_\_\_\_\_ Signature \_\_\_\_\_



**PROPOSAL SUMMARY**  
**DPW ADMIN BUILDING**  
**CONTRACT NO. 2024-10P**

Name of Bidder: \_\_\_\_\_

Name of Contract: \_\_\_\_\_

**TOTAL BID:** \*Lump Sum Amount:

\_\_\_\_\_

(Written in numbers)

\_\_\_\_\_

(Written in words)

Bidder acknowledges receipt of Addenda as follows:

\_\_\_\_\_ Signature \_\_\_\_\_

\_\_\_\_\_ Signature \_\_\_\_\_

\_\_\_\_\_ Signature \_\_\_\_\_

**PROPOSAL SUMMARY**  
**DPW ADMIN BUILDING**  
**CONTRACT NO. 2024-10M**

Name of Bidder: \_\_\_\_\_

Name of Contract: \_\_\_\_\_

**TOTAL BID:** \*Lump Sum Amount:

\_\_\_\_\_

(Written in numbers)

\_\_\_\_\_

(Written in words)

Bidder acknowledges receipt of Addenda as follows:

\_\_\_\_\_ Signature \_\_\_\_\_

\_\_\_\_\_ Signature \_\_\_\_\_

\_\_\_\_\_ Signature \_\_\_\_\_

**PROPOSAL SUMMARY**  
**DPW ADMIN BUILDING**  
**CONTRACT NO. 2024-10E**

Name of Bidder: \_\_\_\_\_

Name of Contract: \_\_\_\_\_

**TOTAL BID:** \*Lump Sum Amount:

\_\_\_\_\_  
(Written in numbers)

\_\_\_\_\_  
(Written in words)

Bidder acknowledges receipt of Addenda as follows:

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Signature

**B. BIDDER'S PROPOSAL AND SIGNATURE**

The bidder agrees that to the City Council of the City of Rye is expressly reserved the right to reject any or all bids or to accept that one of those whose acceptance, in the judgment of the City Council, will best serve the interest of the public. THE BIDDER AGREES THAT HIS BID MAY NOT BE WITHDRAWN WITHIN FORTY-FIVE (45) DAYS AFTER THE DATE BIDS ARE PUBLICLY OPENED, EXCEPT AS OTHERWISE PROVIDED IN SECTION II-F HEREOF.

This proposal is made by: \_\_\_\_\_  
(Name of Bidder)

Bidder's phone number: \_\_\_\_\_

Bidder's email address: \_\_\_\_\_

Bidder's business address: \_\_\_\_\_

Bidder's residence address: \_\_\_\_\_

State whether bidder is an  
individual, a partnership  
or a corporation.

\_\_\_\_\_  
(If a corporation, then corporate seal is required here.)

Signed this \_\_\_\_\_ day \_\_\_\_\_, 20\_\_\_\_\_

\_\_\_\_\_  
(Signature & Title)

STATE OF \_\_\_\_\_ ) SS:  
COUNTY OF \_\_\_\_\_ )

\_\_\_\_\_ being duly sworn, deposes and says that he

resides at \_\_\_\_\_

that he is the

who signed the above proposal or bid, that the bid is the true offer of the Bidder, that the seal attached is the seal of the Bidder and that all the declarations and statements contained in the bid are true to the best of his knowledge and belief.

Subscribed and sworn to before me this \_\_\_\_\_ day of \_\_\_\_\_

20 \_\_\_\_\_.

\_\_\_\_\_  
Notary Public

If the Bidder is a corporation, attached certified copy of the resolution of its Board of Directors authorizing the officer of the corporation who signed the bid, to sign such bid for and on behalf of such corporate bidder.

If a partnership or corporation, give the full names of all partners or all principal officers and manager of the corporation with the title and home address of each:

NAME

TITLE

RESIDENCE ADDRESS

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The undersigned states, when Bidder is a Corporation, that such Corporation was chartered by the State of

\_\_\_\_\_, in the year \_\_\_\_\_, and that its legal address is \_

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The undersigned offers the following information as evidence of his or their facilities, ability and financial resources available for the fulfillment of the Contract, if such be awarded to him or them:

FACILITIES - That he or they own and have available for immediate use on the proposed work, the following plant and equipment:

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ABILITY - That he or they have performed the following work (give location, kind, cost and the names and addresses of clients or chief engineers of the projects):

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FINANCIAL RESOURCES - That information relative to his or their financial resources can and may be obtained from the following:

(Give name, business and address. At least one must be a bank.)

NAME

BUSINESS

ADDRESS

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Upon request, the undersigned will amplify the foregoing statements as may be required and necessary to satisfy the City concerning his or their ability to successfully perform the work in a satisfactory manner within the required time.

**C. PERSONAL EXAMINATION OF WORK, SITE AND DOCUMENTS**

The bidder acknowledges that he has carefully and in person examined the ground, the site of the work, the plans and specifications, the form of the contract, and has read all the notices, information, proposals and the paragraphs which may be attached to the contract and/or specifications as Special Items, and that his bid is not dependent in any way on any statement of any employee of the City as to bidders or other conditions.

**D. CANVASSING OF BIDS**

In submitting the hereinabove bids the undersigned bidder agrees that the lowest total bid for this contract shall be determined by the City Council on the basis of the lowest total bid for which the entire work is to be performed, arrived at by a correct computation of all the items specified in the hereinabove otherwise specifically provided in the said sheet. All other bids shall be canvassed on the same basis.

**E. AGREEMENT TO CONTRACT**

The bidder further agrees to execute the contract and given the required surety bonds and required insurance within ten (10) days from the date of service of a written notice that the said contract has been awarded to such bidder.

**F. DAMAGES FOR FAILURE TO CONTRACT**

If this proposal shall be accepted by the City of Rye and the bidder shall refuse or neglect, within ten (10) days after date of service of the written notice that the Contract has been awarded to such bidder, to execute and deliver the same and to give bonds by a solvent fidelity or surety company authorized by the laws of the State of New York to transact such business in the sum of one hundred per cent (100%) of the price bid as security for payment of labor and materials and the faithful performance of said contract, and furnish the required insurance, which bonds and surety and insurance shall be approved by or be satisfactory to the Corporation Counsel, then the City Council may, at its option, determine that the said bidder has abandoned the contract, and thereupon the proposal and acceptance shall be null and void and the certified check, cashier's check or bid bond accompanying the proposal shall be retained by the City of Rye towards liquidated damages for such neglect or refusal and shall be paid into the General Fund of said City, but, if the said bidder shall execute and deliver the contract and furnish the said security and insurance within the aforesaid time of ten (10) days, the amount of his deposit shall be returned to him.

**G. NON-COLLUSIVE AFFIDAVIT – COMPLIANCE WITH SECTION 103D  
GENERAL MUNICIPAL LAW**

**PART 1 STATE OF \_\_\_\_\_)**

**PART 1 COUNTY OF \_\_\_\_\_) ss:**

\_\_\_\_\_,  
(Here insert full name of owner, partner, officer, representative, or agent of Contractor)

Being first duly sworn, deposes and says that:

1. He is (Owner, partner, officer, representative or agent) of

\_\_\_\_\_  
(Here insert full name and address or legal title of Contractor)  
the Bidder that has submitted the attached Bid;

2. He further states and affirms:

(a) By submission of this bid, each bidder and each person signing on behalf of any bidder certifies, and in the case of a joint bid each party thereto certifies as to its own organization, under penalty of perjury, that to the best of knowledge and belief:

(1) The prices in this bid have been arrived at independently without collusion, consultation, communication, or agreement, for the purpose of restricting competition, as to any matter relating to such prices with any bidder or with any competitor;

(2) Unless otherwise required by law, the prices which have been quoted in this bid have not been knowingly disclosed by the bidder and will not knowingly be disclosed by the bidder prior to opening, directly or indirectly, to any other bidder or to any competitor; and

(3) No attempt has been made or will be made by the bidder to induce any other person, partnership or corporation to submit or not to submit a bid for the purpose of restricting competition.

(b) A bid shall not be considered for award nor shall any award be made where (a) (1), (2), and (3) above have not been complied with; provided, however, that if in any case the bidder cannot make the foregoing certification, the bidder shall so state and shall furnish



with the bid a signed statement which sets forth in detail the reasons therefore. Where (a) (1), (2), and (3) above have not been complied with, the bid shall not be considered for award nor shall any award be made unless the City Council, for its designee, determines that such disclosure was not made for the purpose of restricting competition.

The fact that a bidder has published price lists, rates or tariffs covering items being procured, has informed prospective customers of proposed or pending publication of new or revised prices lists for such items, or has sold the same items to other customers at the same prices being bid, does not constitute, without more, a disclosure within the meaning of subparagraph 2(a) hereof.

3. Any bid hereafter made hereunder by a corporate bidder for work or services performed or to be performed by, goods sold or to be sold, where competitive bidding is required by statute, rule, regulation, or local law, and where such bid contains the certification referred to in subparagraph (a) hereof, shall be deemed to have been authorized by the board of directors of the bidder, and such authorization shall be deemed to include the signing and submission of the bid and the inclusion therein of the certificate as to non-collusion as the act and deed of the corporation.

PART 1 \_\_\_\_\_  
(Signed)

PART 1 \_\_\_\_\_  
(Title)

Subscribed and sworn to before me this

\_\_\_\_\_ Day of \_\_\_\_\_, 20\_\_\_\_

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

**I. VENDOR CONFLICT OF INTEREST QUESTIONNAIRE**Instructions:

Question 1: Enter your name and the name of your business.

Question 2: If you are updating an existing form for a bid or proposal check box 2.

Question 3: Enter the name of the government official or City employee you know where a conflict of interest might exist on the line. If there's none, leave the name of officer blank.

Check "Yes" or "No" in Box A, B, and C

☐ Box A: does the government official or City employee receive income or money from the company the form?

☐ Box B: does the company (person filing) receive income or money from the government official or City employee, not from the government?

☐ Box C: is the filer employed by a company or corporation in which the government official or City employee is officer, or director, or part owner?

☐ Box D: Describe your employment or business relationship with the government official or City employee. If there is none, write "none" in space D.

Question 4: Sign and date the Conflict of Interest form



## CONFLICT OF INTEREST QUESTIONNAIRE

**For vendor or other person doing business with the City of Rye**

This questionnaire is being filed in accordance with New York State General Municipal Law § 103 by a person who has a business relationship with the City of Rye.

By request of the City of Rye this questionnaire must be filed by a vendor that wishes to conduct business or be considered for business with the City. They must declare any business affiliation with a government official or City employee.

The form is a mandatory requirement of a submission of any bid, proposal or contract to the City of Rye. Any bid, proposal, or contract submitted without a signed copy of the Conflict of Interest form shall be considered incomplete and will be rejected by the City.

### OFFICE USE ONLY

Date Received

**1** Name of person who has a business relationship with local governmental entity.

**2** ☐ Check this box if you are filing an update to a previously filed questionnaire.

**3** Name of local government officer/City employee with whom filer has employment or business relationship.

\_\_\_\_\_  
Name of Officer

This section (item 3 including subparts A, B, C & D) must be completed for each officer/City employee with whom the filer has an employment or other business relationship. Attach additional pages to this Form CIQ as necessary.

A. Is the local government officer/City employee named in this section receiving or likely to receive taxable income, other than Investment income, from the filer of the questionnaire?

☐ Yes ☐ No

B. Is the filer of the questionnaire receiving or likely to receive taxable income, other than investment income, from or at the direction of the local government officer/City employee named in this section AND the taxable income is not received from the local governmental entity?

☐ Yes ☐ No

C. Is the filer of this questionnaire employed by a corporation or other business entity with respect to which the local government officer/City employee serves as an officer or director, or holds an ownership of 10 percent or more?

☐ Yes ☐ No

D. Describe each employment or business relationship with the local government officer/City employee named in this section.

**4**

\_\_\_\_\_  
Signature of person doing business with the City of Rye

\_\_\_\_\_  
Date

### SECTION III: CONTRACT AGREEMENT

(To be completed after Contract Award)

City of Rye

**Contract Name**  
**Contract No. 2024-10**\_\_\_\_\_

NOTE: The headings, titles, table of contents and indexes printed or written on the pages following, preceding or attached, are intended for the convenience of reference only, and do not form part of the contract or specifications.

#### A. PARTIES AND DEFINITIONS

This agreement dated as of the \_\_\_\_\_ day of \_\_\_\_\_, 20 \_\_\_\_\_ by and between the City of Rye, a municipal corporation of the State of New York, and hereinafter designated the City, party of the first part, and

hereinafter designated the Contractor, party of the second part.

The parties to these presents, each in consideration of the mutual promises, covenants and agreements herein contained, do hereby covenant, promise and agree each with the others as follows:

#### DEFINITIONS

NOTE: Whenever the words defined in this article, or pronouns used in their stead, occur in this contract and in the Notice to Contractors, Information for Bidders, Bidder's Proposal, Plans and Specifications hereto attached and made a part of this contract, they shall have the meaning here given:

##### 1. Acceptance

Shall mean at the conclusion of the period of maintenance, as provided for herein, and shall be followed by the payment to the Contractor for all monies retained by the City and his release by it from all bond obligations.

##### 2. City - shall mean the City of Rye

3. City Clerk

Shall mean the City Clerk of the City of Rye, or any officer duly authorized by the City Manager of the City of Rye to act for the City in the execution of the work required by this contract.

4. Completion

Shall mean the finishing of all work of a contract and its preparation for test by actual use otherwise and shall be certified to by the engineer. During the maintenance period, as provided for herein, the Contractor, without undue interference with such use, shall maintain his work without extra cost to the City in the condition specified, and his bond and retained percentage shall be held for such performance, as provided herein.

5. Contract

In addition to the portion of this form or document titled "Contract" shall mean and include the "Notice to Contractors", the "Information for Bidders", the "Bidder's Proposal", the "Specifications", and the forms for surety bonds hereto annexed and the "Plans" herein described, and said inclusion are and shall be considered part and parcel of this contract.

6. Contractor

Shall mean the party of the second part above designated entering into this contract for the performance of the work required by it, and the legal representative of said party of the agent appointed to act for said party in the performance of the work.

7. Engineer

Shall mean the person holding the position of or acting in the capacity of the City Engineer of the City of Rye, acting either directly or through his properly authorized agents, such agents acting severally within the scope of the particular duties entrusted to them. Whenever the aforesaid City Engineer by unable to act in consequence of absence or other cause, then such Engineer and assistants as the City Engineer shall designate shall perform all the duties and be vested with all powers herein given to the said City Engineer.

8. Notice

Shall mean written notice. Written notice shall have been deemed to have been duly served when delivered in person to the person, firm or corporation for whom intended, or to his, their or its duly authorized officer, agent, or representative, or when delivered at the last known business address of such person, firm or corporation, or when enclosed in a postage prepaid sealed wrapper or envelope addressed to such person, firm or corporation at his, their or its last known business address, and deposited in the U.S. Mails in a receptacle regularly maintained for such purposes by the government.

9. Plans

Shall mean all the plans of the work accompanying this contract with such subsequent details as the Engineer may give or approve from time to time.

10. Site of Work

Shall mean the immediate locality of the work done or to be done under the contract, including all the land or easements thereto acquired or to be acquired by the City, and any land, park or highway contiguous to the said work, land or easements, and all temporary or permanent storage place of equipment or material in the work.

11. Time

Year, month, week and day shall mean those respective calendar periods unless otherwise specified.

12. Unless the context clearly indicates the contrary, the words directed, required, permitted, ordered, designated, selected, prescribed, or words of like import used in the specifications or upon the plans shall mean, respectively, the direction, requirement, permission, order, designation, selection or prescription of the City Engineer and similarly the words approved, acceptable, satisfactory, equal, necessary, or words of like import shall mean respectively approved by, or acceptable to, or satisfactory to, or equal or necessary in the opinion of the City Engineer.

13. Fiscal Officer

Shall mean the person holding the position of or acting in the capacity of the N.Y. State Commissioner of Labor.

**B. AUTHORITY OF ENGINEER**

1. General

The Engineer will give all orders and directions contemplated under the contract; will determine the amount, quality, acceptability and fitness of the several kinds of work and materials which are to be paid for; will decide every question which may arise relative to the fulfillment of the contract on the part of the Contractor. His estimates and decisions shall be final and conclusive upon said Contractor; and in case any question shall arise between the parties hereto, touching this contract, such estimate and decision shall be a condition precedent to the rights of the Contractor to receive any money under the contract.

The Engineer may stop any work under the contract if the methods or conditions are such that unsatisfactory work might result, or if improper material or workmanship is being used.

The order or sequence of execution of the work and the general conduct of the work shall be subject to the approval of the Engineer who shall have authority to direct the order or sequence where public necessity or welfare shall require, which approval or direction shall, however, in no way affect the sole responsibility of the Contractor in the conduct of the work, nor shall any claim against the City arise or be allowed by reason of any such direction by the Engineer.

## 2. Orders to Foreman

Whenever the Contractor is not present on any part of the work where it may be desired to give directions, orders may be given by the Engineer and shall be received and obeyed by the superintendent or foreman who may have charge of the particular work in reference to which orders are given. All superintendents and foremen shall be English speaking.

## 3. Alterations or Deletions

The Engineer may make alterations or deletions in the line, grade, plan, form, dimensions, or materials or the work or any part thereof, either before or after the commencement of construction. If such deletions or alterations increase or diminish the quantity of work to be done, adjustment for such work under this contract, except that if unit prices are not stipulated for such work, compensation for increased work shall be made under the item of Extra Work, and for decreased work the Contractor shall allow the City a reasonable credit as determined by the Engineer. If such alteration or deletions diminish the quantity of work to be done, they shall not warrant any claim for damages or for anticipated profits on the work that is dispensed with, and the Contractor waives and releases any claim therefor.

## 4. Access to Work, Places of Manufacture and Accounts

The City Engineer inspectors, agents, or other employees, shall for any purpose, and other parties who may enter into contract with the City of Rye for doing work within the territory covered by this contract shall, for all purposes which may be required by the Contract, have access to the work and the premises used by the Contractor and the Contractor shall provide safe and proper facilities therefor.

Furthermore, the City Engineer and his inspector and agents shall, at all times, have immediate access to all places of manufacture where materials are being made for use under this contract and shall be given full facilities for determining that all such materials are being made strictly in accordance with the specifications and plans.

The Contractor shall, whenever requested, provide scales and assistance for weighing, or assistance for measuring any of the materials, and shall give the City's agents and employees access to invoices, bills of lading, payroll, accounts, and memoranda relating to this contract or the work performed or to be performed hereunder.

## 5. Inspection and Exposure

The Engineer shall be furnished with every reasonable facility for ascertaining whether the work is in accordance with the requirements and intentions of this contract, even to the extent of uncovering or taking down portions of finished work.

Should the work thus exposed or examined prove satisfactory, the uncovering or taking down and replacing of the covering or the making good of the parts removed shall be paid for at the contract prices for the class of work done; but, should the work exposed or examined prove unsatisfactory, in the opinion of the Engineer, the uncovering, taking down, replacing and making good shall be at the expense of the Contractor.

## 6. Defective Work

The inspection of the work shall not relieve the Contractor of any of his obligations to fulfill said contract as herein prescribed and defective work shall be made good and unsuitable materials may be rejected, notwithstanding that such work and materials have been previously overlooked by the Engineer and accepted or estimated for payment.

If the work, or any part thereof, shall be found defective before the final acceptance of the whole work, the Contractor shall forthwith make good such defects in a manner satisfactory to the Engineer, and if any material brought upon the ground for use in the work, or selected for the same, shall be condemned by the Engineer as unsuitable or not in conformity with the specifications, the Contractor shall forthwith remove such materials to a satisfactory distance from the vicinity of the work.

# **C. RESPONSIBILITY OF CONTRACTOR**

## 1. General

The Contractor shall do all the work and shall furnish all the materials, tools, and appliances except as herein otherwise specified, necessary or proper for performing and completing the work required by this contract, in the manner and within the time hereinafter specified. The said Contractor shall complete the entire work to the satisfaction of the Engineer and in accordance with the specifications and drawings herein mentioned, at the prices herein agreed upon and affixed therefor. All the work, labor, and materials to be done and furnished under this contract shall be done and furnished strictly pursuant to and in conformity with the attached specifications, and the directions of the Engineer as given from time to time during the progress of the work under the terms of this contract and also in accordance with the Contract Plans, which said Specifications and Plans, together with the Notice to Contractors, the Information for Bidders, and the Bidder's Proposal form parts of this agreement and are approved by the City Council. The Contractor further agrees that all work done or materials furnished shall be of the best of their respective kinds and qualities.



## 2. Contractor's Obligation

The Contractor shall take all the responsibility of the work; the said Contractor shall bear all losses resulting to said Contractor on account of the amount or character of the work, or because the nature of the land in or on which the work is done is different from the assumed or expected, or on account of the weather, floods, or other causes; and the said Contractor shall at said Contractor's own proper cost and expense assume the defense of and indemnify and save harmless the City and the City Engineer and their employees, officers, and agents from all claims of any kind arising from the performance of this contract, whether or not any active or passive or concurrent or negligent act or omission by the City Engineer or any of their employees, officers or agents may have directly or indirectly cause or contributed thereto.

Any expense necessarily incurred by the City in any criminal action or proceedings against any person employed on any work constructed or in the suppression of riots among persons employed on said work, or in the prevention of the commission of crime by such persons, after being duly audited, as required by law, shall constitute a claim in favor of the City of Rye and an action may be maintained on such audit as for money paid to the use of the City and said Contractor shall be responsible to the City for any amount of expense incurred by reason of and upon the grounds set forth hereinabove.

## 3. Contractor to Provide Engineering

The Contractor shall provide his own engineering and/or surveying services to give all lines and grades, including such changes as may be necessitated by unforeseen conditions, and as ordered by the Engineer, and other technical advice necessary for the satisfactory installation of the work. The Contractor shall furnish all stakes, forms, grade boards and templates and shall be responsible for the preservation of grade stakes and for the accurate setting, laying and execution of the work in all its parts. Said Contractor shall also provide the Engineer with all the necessary assistance when required. All stakes set for lines or grades that may be disturbed by the Contractor or the employees of the said Contractor shall be replaced at the expense of said Contractor.

## 4. Contractor to Give Personal Attention

The Contractor shall give the work the constant attention necessary to facilitate the progress thereof and shall cooperate with the Engineer in every possible way.

The superintendent or foreman in charge of the work shall have full authority to execute the orders or the directions of the Engineer without delay and to supply promptly such materials, equipment, tools, labor, and incidentals as may be required.

## 5. Contractor's Mistakes

The Contractor shall pay to the City all Expenses, losses, and damages, as determined by the Engineer, incurred in consequence of any defect, omission, or mistake of the Contractor or his employees, or the making good thereof.

#### 6. Contractor to Employ Sufficient Labor and Equipment

The Contractor shall employ only competent and skillful men to do the work and whenever the Engineer shall notify the Contractor in writing that any man on the work is, in his opinion, incompetent, unfaithful, disorderly or otherwise unsatisfactory, such man shall be discharged from the work and shall not again be employed in it, except with the consent of the Engineer.

If, in the opinion of the Engineer, the Contractor is not employing sufficient labor or sufficient equipment in good repair to complete this contract within the time specified, said Engineer may, after giving written notice, require said Contractor to employ such additional labor and equipment as may be necessary to enable said work to progress properly.

#### 7. Patents and Brands

The Contractor shall be liable for any claims made against the City of any infringements of patents by the use of patented articles in the construction and completion of the work, or any process connected with the work agreed to be performed under this contract or of any materials used upon the said work, and shall indemnify and save harmless the City from all costs, expenses, and damages which the City, the City Engineer, their employees, officers, or agents shall be obliged to pay by reason of any infringement of patents used in the construction and completion of the work.

#### 8. Intoxicating Liquors

The Contractor shall not sell and shall neither permit nor suffer the introduction or use of intoxicating liquors upon or about the work under this contract.

#### 9. Prevention of Dust Hazard

The Contractor agrees that in the event a silica or other harmful dust hazard is created in the construction of the work herein contracted to be done and for which appliances or methods for the elimination of such silica dust or other harmful dust have been approved by the State or local authorities, said Contractor will install, maintain and keep in effective operation such appliances and methods for the elimination of such silica dust or other harmful dust hazard or hazards, and, in the event this provision is not complied with, this contract shall be void.

A violation of this provision shall constitute a misdemeanor and shall be punishable by a fine of not more than \$500 or by imprisonment for not more than one year, or by both fine and imprisonment.

## **D. TIME**

### **1. To Begin Work**

The Contractor shall begin the work embraced in this contract within five (5) calendar days after the service of a written notice by the City Clerk instructing the said Contractor to begin work. It is further agreed by the Contractor, however, that no work shall be begun by said Contractor and no liability incurred on the part of the Contractor nor on the part of the City until the Corporation Counsel of the City of Rye has first approved the payment and performance bonds and insurance required in the contract.

### **2. To Complete Work**

The Contractor shall complete all work embraced in this contract as specified in Section I - SCOPE OF WORK. The allotted time as specified in the SCOPE OF WORK shall commence five (5) days after the Contractor is served with a notice to begin work or after the actual beginning of work by the Contractor, whichever shall occur first, as determined by the Engineer.

In the event the completion time specified in the SCOPE OF WORK is set forth in calendar days, the Contractor agrees that a calendar day shall be any day, including Saturdays, Sundays and legal holidays, and that said completion time amply provides sufficient extra time to adjust for all delays caused by inclement weather conditions and other causes.

In the event the completion time specified in the SCOPE OF WORK is set forth in working days, the Contractor agrees that each day except Saturdays, Sundays and legal holidays shall constitute a working day unless, in the opinion of the Engineer, weather conditions prevent the Contractor from carrying on the work embraced in this contract.

In the event the completion time specified in the SCOPE OF WORK is set forth as a date of completion, the Contractor agrees that delays resulting from weather conditions or any other causes shall not be considered as justifiable reasons for extending the specified date of completion and acknowledges that the specified date of completion amply provides sufficient extra time to adjust for such delays. In the event of unusual or extraordinary causes delaying work progress, the Contractor agrees to employ sufficient extra shifts and employees to complete the work by the date fixed therefor.

The time in which this contract is to be completed is of the essence of this agreement.

### **3. Delay, Suspension and Extension**

The Engineer reserves the right to suspend the whole or any part of the work herein contracted to be done, if he shall deem it in the best interest of the City to do so.

The Contractor agrees to make no claim for damages for delay in the performance of this contract occasioned by any act or omission to act of the City or any of its representatives, and

agrees that any such claims shall be fully compensated for by an extension of time to complete performance of the work as provided herein.

No extension of time will be made for ordinary delays or accidents.

#### 4. Liquidated Damages

The Contractor shall, in addition to any other indemnification provided for elsewhere in this contract, pay to the City all expenses, losses and damages, as determined by the Engineer, incurred in consequence of any negligence, defect, omission or mistake of the Contractor or his employees, or making good thereof, and shall also pay for each and every calendar day, except Saturdays, Sundays and legal holidays, that he shall be in default in completing the entire work to be done under this contract, the sum of \$200.00 for each calendar day (Saturdays, Sundays and legal holidays excluded) of delay, which sum is hereby expressly agreed upon, not as a penalty but as liquidated damages which the City will suffer by reason of such default. The Engineer shall have the right to deduct the amount of any such damage from any Moines due or to become due the Contractor under this contract provided, however, that the Engineer shall have the right in his discretion to extend the time for completion.

#### 5. Abandonment and Suspension

If the work to be done under this contract shall be abandoned by the contractor, or if this contract shall be assigned or the work sublet by said Contractor otherwise than as herein specified, or if at any time the Engineer shall be of the opinion and shall so certify in writing that the performance of this contract is unnecessarily delayed, or that the Contractor is willfully violating any of the conditions or covenants of this contract or of the specifications or is executing the same in bad faith or not in accordance with the terms thereof, or if the work is not fully completed within the time named in this contract for its completion or started as specified for starting, or completed within the time to which completion of the contract may be extended by the City in the manner therein provided, the City may notify the Contractor to discontinue the work, or such part thereof, and the City shall thereupon have the power to complete or contract for the completion of the contract in the manner prescribed by law or to place such and so many persons as the City may deem advisable, by contract or otherwise, upon the work herein described, or such part thereof, and to take possession of and use any of the materials, plant, tools, equipment, supplies and property of every kind provided by the Contractor for the purposes of his work and to procure other materials for the completion of the same, and to charge the expense of such labor and materials to the Contractor. The expense so charged shall be deducted and paid by the City out of such monies as may be due or may, at any time thereafter, become due to the Contractor under and by virtue of this contract, or any part thereof. And in case such expense shall exceed the amount which would have been payable under this contract if the same had been completed by the Contractor, he shall be liable and responsible therefor; and if less he shall forfeit all claim to the difference; and when any particular part of the work is being carried on by the City, by contract or otherwise under the provisions of this article of the contract, the Contractor shall continue the remainder of the work in conformity with the terms of this contract, and in such manner as in no way to hinder or interfere with the persons or workmen employed, as above

provided, by the City by contract or otherwise, to do any part of the work or to complete the same under the provisions of this contract.

The City shall, however, prior to taking possession for completion, notify the Contractor's surety of the Contractor's defaults hereunder and the surety may remedy the defaults by undertaking and commencing due performance within ten (10) days after such notice, and by subsequent diligent performance and completion of the contract; and, if the surety shall not faithfully undertake and commend such performance within said period and thereafter diligently complete or perform at the surety's expense (not in excess of the bond amount) the City may proceed as aforesaid.

However, if, in the City's opinion, any conditions dangerous to life or property shall exist by reason of the Contractor's default, the City may proceed forthwith without notice to the surety, but at the expense of the Contractor and surety, to remedy any such dangerous conditions.

## **E. INSURANCE AND INDEMNITY**

### **1. General**

This contract shall be null and void and of no effect unless the Contractor shall, before entering upon the performance thereof, secure compensation for the benefit of, and keep insured during the life of said contract, all employees engaged thereon who are required to be insured by the Workmen's Compensation Law, in compliance with the provisions of said law and acts amendatory thereto, and as provided in Section 108 of the General Municipal Law of the State of New York.

The Contractor's policy shall include a contractual "hold harmless" clause, exactly as follows:

"The Contractor shall, during the performance of this work, take all necessary precautions and place proper guards for the prevention of accidents, shall put up and keep all night suitable and sufficient lights, and shall indemnify and save harmless the City and its employees, officers and agents, from all claims, suits and actions and all damages and costs to which they may be put by reason of death or injury to all persons or property of another resulting from unskillfulness, willfulness, negligence or carelessness in the performance of the work, or in guarding and protecting the same, or from any improper methods, materials, implements or appliances used in its performance or construction, or by or on account of any direct or indirect act or omission of the Contractor or his employees or agents, and whether or not any active or passive or concurrent or negligent act or omission by the City or any of its employees, officers or agents may have directly or indirectly caused or contributed thereto."

The Contractor shall also take out and maintain during the life of this contract such property damage and public liability insurance in amounts hereinafter specified, as will protect the Contractor (including agents and subcontractors, if any), and the Contractor's employees, officers and agents from any claims from damages to property and/or for personal injuries, including death, arising out of, occurring or caused by operations under this contract by the

Contractor, or by anyone directly or indirectly employed by said Contractor or arising out of this contract.

The Contractor shall also take out and maintain during the life of the contract such contingent property damage and public liability insurance policies in amounts hereinafter specified, as will protect the City of Rye, the City Council, its employees, officers and agents from any and all of the said hereinabove described matters, including a contractual coverage clause setting forth substantially the wording of the Second paragraph of this clause E., subdivision 1.

The Contractor, before execution of this contract by the City Manager, shall file with the City Clerk for his approval one copy of each and every insurance and indemnity policy required by the terms of this contract, or, at the City Clerk's discretion, binders or certificates thereof may be furnished, if acceptable, pending receipt of required policies. Each and every insurance policy required by the terms of this contract shall carry an endorsement to the effect that the insurance company will give at least ten (10) days prior written notice to the City of Rye of any modification or cancellation of any such policy or policies.

Said insurance and indemnity policies or certificates or binder shall be subject to the approval of the Corporation Counsel in regard to company, adequacy and form of protection. The certified check or bid bond submitted with the Contractor's bid may be held for and until such approval has been given. Upon failure of the Contractor to furnish, deliver, and maintain such acceptable binders, the certificates or insurance and renewals as above provided, this contract may, at the option of the City Council, be held willfully violated by the Contractor and may be forthwith declared suspended, discontinued or terminated by the City. Failure of the Contractor to take out and/or maintain any required insurance shall not relieve the Contractor from any responsibility or liability under this contract, nor shall the insurance requirements be construed to conflict with the obligations of the Contractor concerning indemnification.

All required insurance must be in effect and continued so during the life of the contract in not less than the following amounts:

Workmen's Compensation (with Disability Certificate) ..... Unlimited

Limits Required for Contractor's Insurance

General Liability: Bodily Injury & Property Damage  
Aggregate \$ 1,000,000.00

Automobile Liability: Bodily Injury & Property Damage  
Aggregate \$ 1,000,000.00

Protective Policy for City (City of Rye sole named insured)  
General Liability: Bodily Injury & Property Damage  
Aggregate \$ 1,000,000.00

The Owner's or Contractor's Protective Liability Insurance policy shall name the City of Rye as sole insured party.

An original plus one copy of the above insurance certificates will be required.

Blasting or explosives coverage may be required, if and when deemed necessary by the City Engineer, at the commencement of, or during, the contract performance and shall also be subject to approval and permit.

The Contractor agrees to indemnify and save harmless the City of Rye and the public generally therein from all loss, injury and damage caused by or resulting from his storage of explosives or use of explosives or blasting in said City, whether or not such loss, injury or damage be due to negligence of the Contractor or his agents, servants or employees. The foregoing sentence and protection is intended to be for the benefit of persons and property owners in said City, as well as the City, with respect to any such damage, injury or loss sustained.

In the event that claims in excess of the required amounts are made or in the event that claims in excess of the required amounts are made or filed by reason of any operations under the contract, the amount of excess of such claims, or any portion thereof, may be withheld from payments due or to become due the Contractor until such time as the Contractor shall furnish such additional security covering such claims as may be determined by and satisfactory to the City.

## **F. LABOR**

### **1. No Discrimination in Employment**

The Contractor agrees:

- (a) That in the hiring of employees for the performance of work under this contract or any subcontract hereunder, no Contractor, subcontractor, nor any person acting on behalf of such Contractor or subcontractor, shall by reason of race, creed, color or national origin discriminate against any citizen of the United States who is qualified and available to perform the work to which the employment relates,
- (b) that no Contractor, subcontractor, or any person on his behalf shall in any manner discriminate against or intimidate any employee hired for the performance of work under this contract on account of race, creed, color or national origin,
- (c) that there may be deducted from the amount payable to the Contractor by the City of Rye under this contract a penalty of five dollars (\$5.00) for each person for each calendar day during which such person was discriminated against or intimidated in violation of the provisions of the contract; and
- (d) that this contract may be canceled or terminated by the City of Rye and all monies due or to become due hereunder may be forfeited for a second or any subsequent violation of the terms or conditions of this section of the contract.

## 2. Hours of Work

The contractor agrees that no laborers, workmen or mechanics in the employ of the Contractor, subcontractor or other person doing or contracting to do the whole or a part of the work contemplated by the contract shall be permitted or required to work more than eight (8) hours in any one calendar day or more than five (5) days in any one week, except in cases of extraordinary emergency, including fire, flood or danger to life and property. No such person shall be employed more than eight (8) hours in any day or more than five (5) days in any one (1) week except in such emergency.

## 3. Wages Rates and Supplements

The wages and supplements to be paid for a legal day's work to laborers, workmen or mechanics upon such public work, shall be not less than the prevailing rate of wages as shown in Section P. herein.

"Supplements" means all remuneration for employment paid in any medium other than cash, or reimbursement for expenses, or any payments which are not "wages" within the meaning of the law, including but not limited to, health, welfare, nonoccupational disability, retirement, vacation benefits, holiday pay and life insurance.

Where contracts are not awarded within ninety (90) days of the date of establishment of the prevailing rate of wages by the fiscal officer, the department of jurisdiction shall request of the fiscal officer a redetermination of a schedule of wages and supplements.

The said Contractor agrees that any person or corporation that willfully pays or provides, after entering into such contract, less than such stipulated wage scale as established by the fiscal officer shall, in addition to the penalties provided in Section 220 and other applicable provisions of the Labor Law, be subject to forfeiture of the contract at the option of the City Manager for a first offense; and no such person or corporation shall be entitled to receive any sum nor shall any officer, agent or employee of the City pay the same or authorize its payment from the funds under his charge or control to any person or corporation for work done upon any such contract.

The said Contractor agrees that each such laborer, mechanic or workman employed in the performance of this contract, either by the Contractor, a subcontractor, or any other person doing or contracting to do the whole or a part of the work contemplated by the contract, shall be paid not less than such minimum hourly rates of wages and shall be provided supplements not less than the prevailing supplements.

In order to comply with the provisions of the Labor Law of the State of New York, the Contractor further agrees that not less than the schedules of wages and supplements as attached shall be paid and provided to laborers, workmen or mechanics in carrying out the work provided for under this contract.



## **G. LAWS AND REGULATIONS**

### **1. General**

The Contractor and his agents and employees shall at all times observe and comply with all existing and future laws, ordinances, regulations, orders and decrees that in any manner affect their work, including Federal permits and regulations, and shall protect and indemnify the City of Rye, its agents and employees against any claim or liability arising from or based on the violation of any such law, ordinance, regulation, order or decree, whether by himself or by his employees. If any discrepancy or inconsistency should be discovered in this contract, or in the plans or specifications herein referred to, in relation to any such law, ordinance, regulation, order or decree he shall forthwith report the same in writing to the Engineer.

Each and every provision of law and clause required by law to be inserted in this contract shall be deemed to be inserted herein and the contract shall be read and enforced as though it were included herein and if, through mistake or otherwise, any such provision is not inserted, or is not correctly inserted, then upon the application of either party the contract shall forthwith be physically amended to make such insertion.

### **2. Labor and Other Laws**

The Contractor and his agents and employees shall at all times observe and comply with all the applicable provisions of the Labor Law, the Public Health Law, the Lien Law, the Workmen's Compensation Law, the State Unemployment Insurance Law, the Federal Social Security Law, and all rules and regulations promulgated by the Department of Labor of the State of New York, any applicable State or Federal Law, rule or regulation, the Charter of the City of Rye and any Local Laws, ordinances, resolutions or regulations of the City of Rye, and all amendments and additions thereto.

### **3. Refusal to Testify**

Upon the refusal of a person, when called before a grand jury to testify concerning any transaction or contract had with the State, any political subdivision thereof, a public authority or with any public department, agency or official of the State or of any political subdivision thereof or of a public authority, to sign a waiver of immunity against subsequent criminal prosecution or to answer any relevant question concerning such transaction or contract;

- (a) such person, and any firm, partnership or corporation of which he is a member, partner, director or officer shall be disqualified from thereafter selling to or submitting bids to or receiving awards from or entering into any contract with any municipal corporation or any public department, agency or official thereof, for goods, work or services, for a period of five (5) years after such refusal and, also
- (b) any and all contracts made with any municipal corporation or any public department, agency or official thereof, by such person, and by any firm, partnership, or corporation of which he is a member, partner, director or officer may be canceled

or terminated by the municipal corporation without incurring any penalty or damages on account of such cancellation or termination, but any monies owing by the municipal corporation for goods delivered or work done prior to the cancellation or termination shall be paid. (General Municipal Section 103-a)

#### 4. Permits

The Contractor shall, at his own expense, obtain all necessary permits and licenses required by county, state or other public authorities; shall give all notices required by law or ordinances; and shall post all bonds and pay all fees and charges incidental to the due and lawful prosecution of the work covered by this contract. If any of the Contractor's work shall be done contrary to such laws, ordinances, rules and regulations, without such notice, he shall bear all cost arising therefrom.

All fees for City of Rye permits shall be waived.

#### 5. Notice to Consolidated Edison Co.

The Contractor further agrees to comply with General Business Law Art. 36 and shall give prior written notice to consolidated Edison company of New York, Inc., at least seventy-two (72) hours in advance before excavating in any street or public place, and before a proposed discharge of explosives in any location.

#### 6. Code 53

Under Industrial Code Rule 53, the Contractor will be required to notify the Central Registry prior to the start of his work and obtain a listing of the various underground utility operators to be notified of impending work under this contract so they may locate and mark the locations of their utilities upon the pavement. Notification of all operators must be made forty-eight (48) hours prior to the start of any construction. No work by the Contractor shall commence until all the operators have acknowledged being notified and their utilities have been located.

### **H. EXTRA WORK**

#### 1. General

The Contractor shall provide any materials and/or do any work incidental to the proper completion of the contract and not otherwise provided for herein, when and as ordered in writing by the Engineer previous to the commencement of the extra work, in one of the following manners as determined by the Engineer:

##### (a) Contract Prices

Extra work shall be ordered done by the Engineer at the lump sum and/or unit prices set forth in the proposal, when such prices set forth therein cover all or any parts of the proposed extra work.

(b) Negotiated Prices

Extra work may be ordered done by the Engineer at new lump sum and/or unit prices specifically agreed upon before the extra work is commenced.

c) Force Account

Extra work may be ordered done by the Engineer for the reasonable cost of said extra work, as determined by the Engineer, plus a percentage of such cost, to wit:

## (1) Labor

The allowable hourly rates for each laborer and/or mechanic to be paid for under "Extra Work" shall be not more than those set forth on the minimum wage schedules in this contract. The allowable hourly rate for foremen shall be not more than 35% greater than the hourly rate for a common laborer, as set forth on the minimum wage schedules in this contract.

To the amount calculated by multiplying each of the allowable hourly wage rates set forth in the paragraph immediately above by the number of hours worked by each corresponding laborer, mechanic or foreman, shall be added not more than thirty percent (30%) for overhead expenses. This allowance for overhead expenses shall be payment in full for all supplementary wage benefits, Social Security and other direct assessments upon the Contractor's payroll by Federal or other agencies, insurance and bond premiums, supervisory and engineering personnel, office expenses, small tools, buildings and all other expenses of this nature.

To the amount calculated in the manner set forth in the paragraph immediately above shall be added not more than ten percent (10%) thereof for profit. This final maximum allowable amount can be calculated by the following formula:

$$\begin{array}{l} \text{Final Maximum allowable for} \\ \text{extra labor cost} \end{array} = 143\% \times \text{allowable actual wages}$$

## (2) Material

To the actual cost, including all transportation charges, of material incorporated in the work shall be added not more than fifteen percent 15% thereof for overhead and profit. The final maximum allowable amount can be calculated by the following formula:

$$\begin{array}{l} \text{Final maximum allowable for extra material} \\ \text{including all transportation charges} \end{array} = 115\% \times \text{actual cost of material}$$

## (3) Machinery

The customary and usual hourly or daily allowable rates for the necessary rental of all machinery shall be acceptable to the Engineer. These rates include allowances for operators, oilers, fuel, lubricants, maintenance, depreciation, overhead and profit.

The decision of the Engineer shall be final as to the direct or reasonable costs, prices and/or rates of labor, material and machinery rental.

No extra work shall be paid for unless specifically ordered as such in writing by the Engineer before the commencement of the extra work. Unless so ordered, the Contractor waives and releases all claims for compensation therefor.

## 2. Records

If ordered by the Engineer, the Contractor shall submit daily records of all extra work. These daily records shall include the names of the men employed and hours worked, material incorporated into the work, machinery used and work actually accomplished. These daily records shall be signed by both the Contractor's authorized representative and the Engineer.

In addition to the daily records set forth in the paragraph immediately above, the Contractor may be required to submit certified copies, photo copies or Photostats of his payrolls for the days worked, which payrolls shall show the hourly wage rate actually paid to each man.

The Contractor may also be required to submit photo copies or Photostats of the original receipted bills showing the actual costs of all material incorporated in the work.

## 3. Subcontractors

The Contractor shall not be paid any allowance for profit or overhead on extra work done by subcontractors or others.

## 4. Failure to Perform Extra Work

If the Contractor shall decline or fail to perform such extra work or furnish such materials as authorized or ordered by the engineer in writing, as aforesaid, the Engineer may then arrange for the performance of the extra work or the furnishing of the material in any manner as he may see fit, the same as if this contract had not been executed, and the Contractor shall not interfere with such performance of the extra work nor make any claim against the City because of such performance.

## 5. Extension of Time

When extra work is ordered near the completion of the contract, or when extra work is ordered at any time during the progress of the extra work which requires, in the opinion of the Engineer, an unavoidable increase of time for the completion of the contract, a suitable extension of the time for completion shall be made, as may be determined by the Engineer.

## 6. Not to Affect Bonds

It is distinctly agreed and understood that any changes made in the plans and specifications for such extra work or otherwise (whether such changes increase or decrease the amount thereof) or any change in the manner or time of payments made by the City to the Contractor, or extra work performed, shall in no way annul, release or affect the liability or surety on the bonds given by the Contractor.

## **I. PAYMENT**

### 1. Premises for Payment

The Contractor shall not demand nor be entitled to receive payment for the work or materials, or any portion thereof, except in the manner set forth in this contract, nor unless each and every one of the premises, agreements, stipulations, terms and conditions herein contained to be performed, kept, observed and fulfilled on the part of the Contractor shall have been so performed, kept, observed and fulfilled on the part of the Contractor shall have been so performed, kept, observed and fulfilled, and the Engineer shall have given his certificate to that effect, and the City Manager shall have been satisfied with and shall have accepted the work.

### 2. Statements Showing Amounts Due Others

In accordance with Section 220-a of the Labor Law as amended, before payment is made by or on behalf of the City of Rye of any sum or sums due on account of this contract, it shall be the duty of the City Comptroller of the City to require the Contractor and each and every subcontractor from the Contractor or a subcontractor to file a statement in writing in form satisfactory to such Comptroller certifying to the amounts then due and owing from such Contractor or subcontractor filing such statement to or on behalf of any and all laborers for daily or weekly wages or supplements on account of labor performed upon the work under the contract, setting forth therein the names of the persons whose wages or supplements are unpaid, and the amount due to each or on behalf of each respectively, which statement so to be filed shall be verified by the oath of the Contractor or subcontractor as the case may be that he has read such statement subscribed by him and knows the contents thereof, and that the same is true of his own knowledge.

### 3. Amounts Due for Wages May be Withheld

In accordance with Section 200-b of the Labor Law as amended, in case any interested person shall have previously filed a protest in writing objecting to the payment to any Contractor or subcontractor to the extent of the amount or amounts due or to become due to him for daily or weekly wages or supplements for labor performed on the public improvement for which such contract was entered into, or if for any other reason it may be deemed advisable, the City Comptroller of the City of Rye may deduct from the whole amount of any payment on account thereof the sum or sums admitted by any Contractor or subcontractor in such statement or statements so filed to be due and owing by him on account of labor performed on such public improvement before making payment of the amount certified for payment in any estimate or

voucher, and may withhold so deducted for the benefit of the laborers whose wages or supplements are unpaid or not provided, as shown by the verified statements filed by any Contractor or subcontractor, and may pay directly to any person the amount or amounts shown to be due to him or his duly authorized collective bargaining labor organization for such wages or supplements by the statements filed as hereinbefore required, thereby discharging the obligation of the Contractor or subcontractor to the person or his duly authorized collective bargaining labor organization receiving such payment to the extent of the amount thereof, or when any interested person shall file a written complaint with the Comptroller of the City of Rye alleging unpaid wages or supplements due for labor performed on a public improvement for which a contract has been entered into or if, on the said Comptroller's own initiative, unpaid wages or supplements appear to be due, the Comptroller of the City of Rye shall immediately so notify the financial officer of the civil division interested who shall withhold from any payment on account thereof, due the Contractor or subcontractor executing said public improvements, sufficient monies to satisfy said wages and supplements pending a final determination as further set forth in said Section 220-a.

#### 4. Liens

If, at any time before or within thirty (30) days after the whole work herein agreed to be performed, and all labor and materials herein agreed to be delivered to the City have been performed and delivered or completed and accepted by the City, any person or persons claiming to have performed any labor or furnished any materials towards the performance or completion of this contract shall file with the City Clerk any such notice as is described in the New York State Lien Law, the City Comptroller shall retain until and for the discharge the amount in such notice claimed to be due, together with the costs of any actions or proceedings brought to enforce such claim or lien by filing of such notice.

#### 5. Money May be Retained

The City may keep monies which would otherwise be payable at any time hereunder, and apply the same or so much as may be necessary therefor to the payment of any expenses, losses, or damages as determined by the Engineer, incurred by the City and may retain until all claims shall have been satisfied and/or settled, so much of such monies as the City Manager shall be of the opinion will be required to settle in full all claims, and the costs and expenses thereof against the City, its employees, officers and agents as described in this agreement and all claims for labor on the work and also all those claims for materials for the work, notice of which, signed and sworn to by the claimants, shall have been filed in the office of the City Clerk, or the City may make such settlement and apply thereto any monies retained under this contract.

#### 6. Prices for Work

The City shall pay and the Contractor shall receive in full compensation for furnishing all materials and labor and for performing and completing all work which is necessary or proper to be furnished or performed in order to complete the entire work in this contract and described and specified, and in such

specifications and plans described and shown and also for all loss or damages arising out of the nature of the work aforesaid, or from the action of the elements, or from any unforeseen obstruction or difficulty encountered in the prosecution for the work and for all risks of any description connected with the work and for all expenses incurred by or in consequence of the suspension or discontinuance of any work as herein specified, the lump sum and/or unit prices named in the Bidder's Proposal, attached hereto and made a part hereof, the same to be in full force and effect as though here repeated.

#### 7. Partial Estimates

In order to assist the Contractor to prosecute the work advantageously, the Engineer, from time to time as the work progresses but not oftener than once a month, shall make in writing an estimate of the amount and value of the work done and materials incorporated in the work by the Contractor in the performance of this contract.

The first such estimate shall be of the amount and value of work done and materials incorporated in the work since the Contractor commenced the performance of this contract on his part, and every subsequent estimate, except the final estimate, shall be of the amount and value of the work done and materials incorporated in the work since the last preceding estimate was made; provided, however, that no such estimate shall be made when, in the judgment of the Engineer, the total value of the work done and materials incorporated in the work since the last preceding estimate amounts to less than TWO THOUSAND DOLLARS (\$2,000.00)

No materials not incorporated in the work and none of the Contractor's plant shall be included in partial estimates. Such estimates shall not be required to be made by precise measurements, but they may be made by measurement or by estimation, or partly by one method and partly by the other, and it shall be sufficient if they are approximate only.

#### 8. Partial Payment

Upon each estimate being made and certified by the Engineer in writing to the City Comptroller, the City shall within fifteen (15) days after the date of the estimate, pay to the Contractor ninety-five percent (95%) of the amount stated in such estimate or certificate to be the value of the work done and materials furnished, retaining, however, in addition to the remaining unpaid percentage, any sum or sums which by the terms of this contract or by laws of the State of New York, the City is or may be authorized. Such payment shall not be used as evidence against the City that the work already done has been completed according to Contract, nor shall it preclude the City from contesting the claims of the Contractor that the work has been completed according to Contract.

#### 9. Withholding of Payments

The payments under an estimate provided for by this agreement may at any time be withheld or reduced if, in the opinion of the Engineer, the work is not proceeding in accordance with the contract; or if the required insurance policies have not been furnished by the Contractor and approved by the Corporation Counsel.

If the Contractor fails to meet and pay all of his just obligations outstanding for labor, materials, and/or supplies at the time when an estimate for payment is due him, or if any liens, claims or demands arising out of in connection with the work or its performance shall be outstanding at the time any payment may be due or is likely to be made thereafter, or if any claims arising out of or in connection with the Contractor's operations under this contract are made against the party of the first part by any other person than the Contractor, or, if in the opinion of the City Engineer, the Contractor is not proceeding with the work in accordance with the provisions of this contract, the City shall have the right to withhold out of any payments, final or otherwise, such sums as the City Manager deems ample to protect the City against delay or loss and/or to assure the payment of just claims of third persons and, at its option as agent for the Contractor, to apply such sums in such manner as the City Manager may deem proper to secure such protection and/or to satisfy such claims. The City shall also have the right to withhold from the Contractor so much of the accrued payments as may be necessary to pay to laborers or mechanics employed on the work the difference between the rate of wages and supplements required by this contract to be paid laborers or mechanics on the work and the rate of wages and supplements actually paid to such laborers or mechanics. Such application shall be deemed payments for the Contractor's account. The Engineer may withhold payment to the Contractor on account of the failure of the Contractor to fully comply with any requirements of the contract.

#### 10. Final Estimate

Whenever, in the opinion of the Engineer, the Contractor shall have completely performed this contract on the part of said Contractor to be performed, excepting maintenance, the Engineer shall so certify to the City Manager, and his certificate shall state from actual measurements the whole amount of work performed by the Contractor and also the total value of such work performed under and according to the terms of this contract. All prior certificates upon which partial payments may have been made, being merely approximate estimates, shall be subject to correction in the final estimate, which final estimate may be made without notice to the Contractor thereof or of the measurements upon which it is based.

The final estimate shall act as and have the same force and effect as the Engineer's certificate of completion. The date of the final estimate shall be the date of completion of the work and shall be the date upon which the period of maintenance described hereinafter shall begin.

#### 11. Correction of Estimate

The City shall not, nor shall any department or officer thereof, be precluded or stopped, by any return or certificate made or given by the Engineer or any other officer, agent or employee of the City under any provision of this contract, from at any time either before or after the final completion and acceptance of the work and payment therefor pursuant to any such return or certificate showing the true and correct amount and character of the work done and materials furnished by the Contractor or any other person under this agreement or from showing at any time that any such return or certificate is untrue and incorrect or improperly made in any particular, or that the work and materials or any part thereof do not in fact conform to the specifications, and the City shall not be precluded or stopped, notwithstanding any such return



or certificate and payment in accordance therewith, from demanding and recovering from the Contractor such damage as it may sustain by reason of his failure to comply with the specifications.

Neither the acceptance of the City Clerk or the City Engineer, or any of his agents nor any other measurement or certificate of the Engineer, not any order of the City Manager for payment of money nor any payment for, nor acceptance of the whole or any part of the work by the Engineer or the City Clerk, nor any extension of time, nor any possession taken by the City of Rye or its employees, shall operate as a waiver of any right of the City pursuant to this contract or of any power herein reserved to it or of any rights of the City to damages as herein provided.

#### 12. Five Per Cent to be Retained

On the expiration of thirty (30) days after the completion of the work agreed to be done by the Contractor and the filing of a certificate of such completion of the work in the office of the City Clerk and of the City Comptroller signed by the Engineer and the City Manager, the City shall pay to the Contractor by warrant or check of the City the amount remaining after deducting from the total value of the work performed according to the terms of the contract five per cent (5%) of the said total value and also all such sums as shall theretofore have been paid to the Contractor under any of the provisions of this contract and also any sum or all sums of money as by the terms hereof the City is or may be authorized to reserve or retain, provided that nothing herein mentioned shall be construed to affect the right, hereby reserved, of the City Engineer to reject the whole or any portion of the aforesaid work, inconsistent with the terms of this agreement, or otherwise. Thereafter the said amount of five per cent (5%) of the total amount of the work performed according to the terms of the contract, as hereinabove mentioned, shall be retained by the City until the conclusion of and during the period of maintenance, which period of maintenance is hereinafter described.

It is agreed that the City may keep the whole or any portion of the sum retained, for settlement of all claims arising out of this contract against the City, its officers or agents and for all expenses, losses or damages incurred by the City by reason of said claims.

#### 13. Final Estimate to End Liability

No person or corporation, other than the signer of this contract as Contractor, now has any interest hereunder, and no claim shall be made or filed by any such person or corporation and neither the City nor any of its agents shall be liable or held to pay any monies except as provided for hereinabove. The acceptance by the Contractor of the final estimate aforesaid shall operate as, and shall be a release to the City and its agents from all claims and liability from anything done or furnished for, or relating to the work, or for any act or neglect of the City or of any agent, relating to or affecting the work, excepting the claim against the City for the remainder, if there be any, of the amounts kept or retained.

## **J. PERIOD OF MAINTENANCE**

### **1. General**

The Contractor shall be responsible for the entire work until the time of its acceptance and shall also keep and maintain every portion of it in perfect order and repair for a period of six (6) months after completion of said work, excepting in regard to such damages as may be directly caused by the City or Rye, its agents or servants, and except as provided hereinafter.

At the conclusion of the said period of maintenance, the work may be accepted, provided it be then in good order and repair, that it conform entirely with the required lines, grades and dimensions, and if all other obligations on the part of the Contractor under this contract have been fulfilled. Upon certification by the Engineer to the above effect, the bonds retained shall be release. If, at any time during the period of maintenance, the Contractor, after notice by the Engineer, shall fail to promptly repair and/or make good any defect or damage in the work, then and in that case the City shall have the right to cause such defect or damage to be repaired and made good by the City's own forces or by such other parties as may be selected by said City and to charge to the Contractor the cost of all labor, materials, plant, equipment and other incidental expenses necessary to such repair and making good. Said cost shall be charged against the retained bonds.

All questions of disputes in regard to repairs required during the period of maintenance shall be resolved by the City Manager, whose determination shall be conclusive.

## **K. MISCELLANEOUS CONTRACT DATA**

### **1. Plans and Specifications Cooperative**

The plans and specifications are intended to be explanatory of each other, but should any discrepancy appear or any misunderstanding arise as to the import of anything contained in either, the interpretation and decision of the Engineer shall be final and binding on both parties to this contract.

Any correction of errors or omission in plans and specifications may be made by the Engineer when such correction is necessary for the proper fulfillment of their intention as construed by him. Where said correction of errors or omissions, except as provided in the next two paragraphs below, adds to the amount of work to be done by the Contractor, compensation for said additional work shall be make under the item for Extra Work, except where the additional work may be classed under some item of work for which a unit price is included in the Proposal.

The fact that specific mention of a fixture or of any part of the work is omitted in the specifications, whether intentionally or otherwise, when the same is clearly indicated on the plans, or is usually and customarily required to complete fully such work as is specified herein, will not entitle the Contractor to consideration in the matter of any claim for extra compensation, but the said fixtures or work or both shall be installed or done the same as if called for both by the plans and the specifications.

All work indicated on the plans and not mentioned in the specifications, or vice versa, and all work and material usual and necessary to make the work complete in all its parts, whether or not they are indicated on the plans or mentioned in the specifications, shall be furnished and executed the same as if they were called for, both by the plans and specifications.

2. Ownership of Materials

Nothing in this contract shall be considered as vesting in the Contractor any right or property in materials used after they shall have been attached or affixed to the work on the soil, but all such materials shall, upon being so attached or affixed, become the property of the City.

3. City's Representatives Only

It is understood and agreed between the parties hereto, that the City of Rye, its officers, employees and agents are acting in a representative capacity and not for their own benefit, and that nothing contained in this contract shall be deemed to vest in the Contractor or said Contractor's representatives, successors, or assigns, or said Contractor's agents, servants or employees, any claim against any of them as individuals.

4. Limitation of Waiver Clause

No waiver by the City or the City Engineer of any breach of this contract shall be held to be a waiver of any other or subsequent breach. Any illegality or error in one or more clauses comprising any part or parts of this contract will not make the remainder of the contract void.

5. Assignment Restricted

Said Contractor shall not assign, transfer, convey, sublet or otherwise dispose of this contract, or his rights, title or interest in or to the same or any part thereof, without the previous consent in writing of the City Manager endorsed hereon or annexed hereto, and said Contractor shall not assign by power of attorney or otherwise any of the monies due or to become due and payable under this contract unless by and with said consent, signified in like manner. If the Contractor shall, without such previous written consent, assign, transfer, convey, sublet or otherwise dispose of this contract, or if his right, title or interest herein or any of the monies due or to become due under this contract, to any such person, company or other corporation, this contract may, at the option of the City of Rye, be revoked and annulled and all liability and obligations of the City of Rye growing out of the same to the Contractor and to his assignee or transferee shall cease and be at an end as of the date and time of such assignment, transfer, conveyance, subletting or other disposition of this contract, provided that nothing herein contained shall be construed to hinder, prevent or affect an assignment by the Contractor's creditors, made pursuant to the Statutes of the State of New York; and no right under this contract or to any money due or to become due hereunder, shall be asserted against the City by said Contractor or his agents, assignees, transferees, or other persons who may acquire any interest in law or equity by reason of any so called assignment of this contract, or any part thereof of any monies due or to grow due hereunder, unless authorized as aforesaid by the written consent of the City Manager.

6. Contractor's Address for Service

The business address given in the Bid or Proposal upon which the contract is founded is hereby designated as the place to which letter or other communications under this contract shall be mailed or delivered to the Contractor.

Such address may be changed at any time by an instrument in writing executed and acknowledged by the Contractor and delivered to the Office of the City Clerk. Nothing herein contained shall be deemed to preclude or render inoperative the service of any notice, letter or other communication upon the Contractor personally at such address or any other place in this State.

7. Contract Binding on Successors

All of the stipulations and agreements aforesaid shall apply and bind the heirs, executors, administrators and successors of the respective parties hereto, but this clause shall not be deemed a consent to any assignment of this contract.

**L. EXECUTION OF CONTRACT**

IN WITNESS WHEREOF THE respective parties hereto have caused this contract to be executed and delivered as of the day and year first above written.

(city seal)

THE CITY OF RYE

BY:

\_\_\_\_\_  
City Manager

(Contractor's Corporate  
Seal if any)

\_\_\_\_\_  
Contractor

BY:

\_\_\_\_\_  
Title

\_\_\_\_\_  
Address

## ACKNOWLEDGMENT OF THE CITY MANAGER

STATE OF NEW YORK           )  
CITY OF RYE                 ) SS:  
COUNTY OF WESTCHESTER   )

On this            day of                          , 20         , before me personally came \_\_\_\_\_, to me known, who being by me duly sworn, did depose and say that he resides in the City of Rye, that he is the City Manager of the City of Rye, the corporation described in and which executed the above instrument; that he knows the seal of said corporation; that the seal affixed to said instrument is such corporate seal; that it was affixed by order of the Common Council of said corporation and she signed her name thereto by like order.

Notary Public, Westchester County

### ACKNOWLEDGMENT IF CONTRACTOR IS A CORPORATION

STATE OF NEW YORK )  
 ) SS:  
COUNTY OF )

On this                      day of                      , 20     , before me personally  
appeared,                      to me known, who, being by me duly sworn, did depose  
and say, that he resides at

that he is the \_\_\_\_\_ of \_\_\_\_\_

the corporation described in and which executed the within instrument; that he knows the seal of said corporation; that the seal affixed to said instrument was such corporate seal; that it was so affixed by order of the Board of Directors of said corporation, and that he signed his name thereto by like order.

Notary Public, \_\_\_\_\_ County

City of Rye, New York



**M. SAMPLE FORM - PERFORMANCE BOND**


---

(Name of Bonding Company)

---

(Address)

KNOW ALL MEN BY THESE PRESENTS, THAT WE \_\_\_\_\_

---

(Insert Name and Address of Contractor)

hereinafter referred to as the Principal, and \_\_\_\_\_

---

(Name and State of Incorporation of Surety)

hereinafter referred to as the Surety, are held and firmly bound unto THE CITY OF RYE, a municipal corporation located in the County of Westchester, New York, hereinafter referred to as the City, in the sum of \_\_\_\_\_

---

(Words and Figures)

DOLLARS lawful money of the United States of America, to be paid to the City of Rye, or to its certain attorneys, successors, or assigns, for which payment will and truly be made, we bind ourselves and our several and respective heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

Sealed with our seals. Dated this \_\_\_\_\_ day of \_\_\_\_\_  
 \_\_\_\_\_ in the year Two Thousand and \_\_\_\_\_.

WHEREAS, the above bounded Principal, by an instrument in writing, signed by the Principal, as Contractor, and bearing even date with or a date prior to these presents, has contracted with the City to perform all the work and furnished all the materials and plant called for in the said contract for \_\_\_\_\_

---

(Insert Full Description and Number of Contract)

---

which contract is by reference made a part hereof.

---

City of Rye, New York



NOW, THEREFORE, if the Principal shall well and truly perform and fulfill all the undertakings, covenants, terms, conditions and agreements of said contract during the original term of said contract and any extensions thereof that may be granted by the City, with or without notice to the Surety, and during the life of any guaranty required under the contract, and shall also well and truly perform and fulfill all the undertakings, covenants, terms, conditions, and agreements of any and all duly authorized modifications of said contract that may hereafter be made, notice of which modifications to the Surety being hereby waived, then these obligations shall be void, otherwise to remain in full force and effect.

And, the Surety, for value received, hereby stipulates and agrees that no change, extension of time, deletion or alteration or addition to the terms of the contract or to the work to be performed thereunder or to the plans and specifications accompanying the same shall in any way affect or limit or release its obligation of this bond.

No right of action shall accrue on this bond to or from the use of any person or corporation other than the City named herein or its successors.

\_\_\_\_\_  
(Name of Contractor) Principal

(Corporate Seals Required)

By: \_\_\_\_\_  
(Signature and Title)

\_\_\_\_\_  
(Name of Surety)

By: \_\_\_\_\_  
(Signature and Title)

(Surety bond to be approved, as to form and correctness, by the Corporation Counsel of the City of Rye.)

(Qualifications of Surety company, and proper acknowledgments to be annexed thereto.)

(Surety company must be authorized by the State of New York to transact business.)



County

**N. SAMPLE FORM - PAYMENT BOND (Labor & Materials)**


---

(Name of Bonding Company)

---

(Address)

KNOW ALL MEN BY THESE PRESENTS, THAT WE \_\_\_\_\_

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(Insert Name and Address of Contractor)

hereinafter referred to as the Surety, are held and firmly bound unto THE CITY OF RYE, a municipal corporation located in the County of Westchester, New York, herein after referred to as the City, in the sum of \_\_\_\_\_

(Words and Figures)

Dollars, lawful money of the United States of American, to be paid to the City of Rye, or to its certain attorneys, successors or assigns for the use and benefit of claimants supplying labor and/or materials for the work hereinafter specified, for which payment well and truly be made, we bind ourselves and our several and respective heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

Sealed with our seals. Dated this \_\_\_\_\_ day of \_\_\_\_\_ in the year Two Thousand and \_\_\_\_\_.

WHEREAS, the above bounded Principal, by an instrument in writing, signed by the Principal, as Contractor, and bearing even date with or a date prior to these presents, has contracted with the City to perform all the work and furnished all the materials and plant called for in the said contract for \_\_\_\_\_

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(Insert Full Description and Number of Contract)

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which contract is by reference made a part hereof.

NOW, THEREFORE, if the Principal shall promptly make payment to all claimants supplying labor and/or material used or reasonable required for use in the prosecution and performance of the work provided for in said contract, and any and all duly authorized modifications of said contract that may hereafter be made, notice of which modifications to the Surety being hereby waived, then this obligation shall be void, otherwise to remain in full force and effect, subject to the conditions specified below.

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City of Rye, New York

Any beneficiary-claimant hereunder who has not been paid in full within ninety (90) days after the date on which the last of such claimant's work or labor was done or performed or materials furnished, may sue the Surety and Principal in this bond for such sum as may be justly due, provided, however, that no such suit or action shall be commenced hereunder by such claimant after the expiration of one (1) year following the date on which the Principal ceased work on said contract nor other than in a State Court or the United States District Court of competent jurisdiction in and for the County of District in which the contract work is situated. The amount of this bond shall be reduced by and to the extent of payments made in good faith hereunder, inclusive of the payment by Surety of any mechanics; liens which may be filed of record against said improvement pursuant to said contract, whether or not claim for the amount of such mechanics' liens be presented under and against this bond.

And the Surety, for value received, hereby stipulates and agrees that no change, extension of time, deletion or alteration or addition to the terms of the contract or to the work to be performed thereunder or to the plans or specifications accompanying the same shall in any way discharge or limit or release its obligation on this bond.

\_\_\_\_\_  
(Name of Contractor) Principal

(Corporate Seals Required

BY: \_\_\_\_\_  
(Signature and Title)

\_\_\_\_\_  
(Name of Surety)

BY: \_\_\_\_\_  
(Signature and Title)

(Surety bond to be approved, as to form and correctness, by the Corporation Counsel of the City of Rye.)

(Qualifications of Surety company, and proper acknowledgments to be annexed thereto.)

ACKNOWLEDGMENT BY PRINCIPAL UNLESS IT BE A CORPORATION

STATE OF NEW YORK                     )  
   ) SS:  
COUNTY OF                             )

On this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_\_, before me  
personally came \_\_\_\_\_  
\_\_\_\_\_ to me known and known to me to be the person described in \_\_\_\_\_ and who executed the  
foregoing instrument, and acknowledged that he executed the same.

Notary Public \_\_\_\_\_ County \_\_\_\_\_

**ACKNOWLEDGMENT BY PRINCIPAL, IF A CORPORATION**

STATE OF NEW YORK )  
 ) SS:  
COUNTY OF )

On this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_\_,  
before me personally came \_\_\_\_\_  
to me known, who, being by me duly sworn, did depose and say that he resides in \_\_\_\_\_  
of \_\_\_\_\_  
, the corporation described in and which executed the within instrument; that he knows  
the seal of said corporation; that the seal affixed to said instrument is such corporation, and that  
he signed his name thereto by like order.

---

Notary Public
County

(Seal, If Required)

### ACKNOWLEDGMENT BY SURETY COMPANY

STATE OF NEW YORK                     )  
   ) SS:  
COUNTY OF                               )

On this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_\_, before me  
personally came \_\_\_\_\_

to me known, who, being by me duly sworn, did depose and say that he resides in \_\_\_\_\_; that he is the

of

\_\_\_\_\_, the corporation described in and which executed the within instrument; that he knows the seal of said corporation; that the seal affixed to said instrument is such corporate seal; that it was so affixed by order of the Board of Directors of said corporation, and that he signed his name thereto by like order; and that the liabilities of said company do not exceed its assets as ascertained in the manner provided by the Laws of the State of New York, and the said

further said that he is acquainted with

and knows him to be the \_\_\_\_\_ of said  
company, that the signature of the said \_\_\_\_\_

subscribed to the within the said instrument is the genuine handwriting of  
the said

and was subscribed thereto by like order of the Board of Directors, in the presence of him  
the said

Notary Public	County
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**O. SAMPLE FORM - MAINTENANCE BOND**


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(Name of Bonding Company)

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(Address)

KNOW ALL MEN BY THESE PRESENTS, THAT WE \_\_\_\_\_

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(Insert Name and Address of Contractor)

hereinafter referred to as the Principal, and \_\_\_\_\_

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(Name and State of Incorporation of Surety)

hereinafter referred to as the Surety, are held and firmly bound unto THE CITY OF RYE, a municipal corporation located in the County of Westchester, New York, hereinafter referred to as the City, in the sum of \_\_\_\_\_

(Words and Figures)

DOLLARS lawful money of the United States of America, to be paid to the City of Rye, or to its certain attorneys, successors, or assigns, for which payment will and truly be made, we bind ourselves and our several and respective heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

Sealed with our seals. Dated this \_\_\_\_\_ day of \_\_\_\_\_ in the year Two Thousand and \_\_\_\_\_.

WHEREAS, the Principal heretofore entered into written contract with the City for \_\_\_\_\_

WHEREAS, said Contract provides that the Principal shall guarantee



NOW, THEREFORE, the condition of this obligation is such that if the above Principal shall indemnify the City against any loss by reason of his failure to make good at his own expense any defects or deficiencies in materials or workmanship which may appear in the work under said contract within the period of \_\_\_\_\_ months from the date of acceptance of the work, then this obligation shall be void; otherwise to remain in full force and effect.

\_\_\_\_\_  
(Principal)

BY: \_\_\_\_\_

Attest \_\_\_\_\_  
(Signature)

BY: \_\_\_\_\_

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

BY: \_\_\_\_\_

SEAL

(Principal acknowledgment, Corporation acknowledgment and Surety acknowledgment to be annexed hereto.)



the corporation described in and which executed the within instrument; that he knows the seal of said corporation; that the seal affixed to said instrument is such corporate seal; that it was so affixed by order of the Board of Directors of said corporation, and that he signed his name thereto by like order; and that the liabilities of said company do not exceed its assets as ascertained in the manner provided by the Laws of the State of New York, and the said further said that he is acquainted with and knows him to be the of said company, that the signature of the said subscribed to the within the said instrument is the genuine handwriting of the said and was subscribed thereto by like order of the Board of Directors, in the presence of him the said.

County

**P. SCHEDULES OF MINIMUM WAGE RATES AND SUPPLEMENTS**



Kathy Hochul, Governor

Roberta Reardon, Commissioner

City of Rye DPW  
Eric Kingsbury  
141 Oakland Beach Avenue  
Rye NY 10580

Schedule Year 2024 through 2025  
Date Requested 09/23/2024  
PRC# 2024012100

Location City of Rye  
Project ID# 2024-10  
Project Type Project consists of the demolition of an existing DPW garage building and the construction of a new, multiuse, garage and administrative office building. Also new electrical service and solar power

### PREVAILING WAGE SCHEDULE FOR ARTICLE 8 PUBLIC WORK PROJECT

Attached is the current schedule(s) of the prevailing wage rates and prevailing hourly supplements for the project referenced above. A unique Prevailing Rate Case Number (PRC#) has been assigned to the schedule(s) for your project.

The schedule is effective from July 2024 through June 2025. All updates, corrections, posted on the 1st business day of each month, and future copies of the annual determination are available on the Department's website [www.labor.ny.gov](http://www.labor.ny.gov). Updated PDF copies of your schedule can be accessed by entering your assigned PRC# at the proper location on the website.

It is the responsibility of the contracting agency or its agent to annex and make part, the attached schedule, to the specifications for this project, when it is advertised for bids and /or to forward said schedules to the successful bidder(s), immediately upon receipt, in order to insure the proper payment of wages.

Please refer to the "General Provisions of Laws Covering Workers on Public Work Contracts" provided with this schedule, for the specific details relating to other responsibilities of the Department of Jurisdiction.

Upon completion or cancellation of this project, enter the required information and mail **OR** fax this form to the office shown at the bottom of this notice, **OR** fill out the electronic version via the NYSDOL website.

#### NOTICE OF COMPLETION / CANCELLATION OF PROJECT

Date Completed: \_\_\_\_\_ Date Cancelled: \_\_\_\_\_

Name & Title of Representative: \_\_\_\_\_

Phone: (518) 457-5589 Fax: (518) 485-1870  
W. Averell Harriman State Office Campus, Bldg. 12, Room 130, Albany, NY 12240



# **General Provisions of Laws Covering Workers on Article 8 Public Work Contracts**

## **Introduction**

The Labor Law requires public work contractors and subcontractors to pay laborers, workers, or mechanics employed in the performance of a public work contract not less than the prevailing rate of wage and supplements (fringe benefits) in the locality where the work is performed.

## **Responsibilities of the Department of Jurisdiction**

A Department of Jurisdiction (Contracting Agency) includes a state department, agency, board or commission; a county, city, town or village; a school district, board of education or board of cooperative educational services; a sewer, water, fire, improvement and other district corporation; a public benefit corporation; and a public authority awarding a public work contract.

The Department of Jurisdiction (Contracting Agency) awarding a public work contract **MUST** obtain a Prevailing Rate Schedule listing the hourly rates of wages and supplements due the workers to be employed on a public work project. This schedule may be obtained by completing and forwarding a "Request for wage and Supplement Information" form (PW 39) to the Bureau of Public Work. The Prevailing Rate Schedule **MUST** be included in the specifications for the contract to be awarded and is deemed part of the public work contract.

Upon the awarding of the contract, the law requires that the Department of Jurisdiction (Contracting Agency) furnish the following information to the Bureau: the name and address of the contractor, the date the contract was let and the approximate dollar value of the contract. To facilitate compliance with this provision of the Labor Law, a copy of the Department's "Notice of Contract Award" form (PW 16) is provided with the original Prevailing Rate Schedule.

The Department of Jurisdiction (Contracting Agency) is required to notify the Bureau of the completion or cancellation of any public work project. The Department's PW 200 form is provided for that purpose.

Both the PW 16 and PW 200 forms are available for completion [online](#).

## **Hours**

No laborer, worker, or mechanic in the employ of a contractor or subcontractor engaged in the performance of any public work project shall be permitted to work more than eight hours in any day or more than five days in any week, except in cases of extraordinary emergency. The contractor and the Department of Jurisdiction (Contracting Agency) may apply to the Bureau of Public Work for a dispensation permitting workers to work additional hours or days per week on a particular public work project.

## **Wages and Supplements**

The wages and supplements to be paid and/or provided to laborers, workers, and mechanics employed on a public work project shall be not less than those listed in the current Prevailing Rate Schedule for the locality where the work is performed. If a prime contractor on a public work project has not been provided with a Prevailing Rate Schedule, the contractor must notify the Department of Jurisdiction (Contracting Agency) who in turn must request an original Prevailing Rate Schedule from the Bureau of Public Work. Requests may be submitted by: mail to NYSDOL, Bureau of Public Work, State Office Bldg. Campus, Bldg. 12, Rm. 130, Albany, NY 12226; Fax to Bureau of Public Work (518) 485-1870; or electronically at the NYSDOL website [www.labor.ny.gov](http://www.labor.ny.gov).

Upon receiving the original schedule, the Department of Jurisdiction (Contracting Agency) is **REQUIRED** to provide complete copies to all prime contractors who in turn **MUST**, by law, provide copies of all applicable county schedules to each subcontractor and obtain from each subcontractor, an affidavit certifying such schedules were received. If the original schedule expired, the contractor may obtain a copy of the new annual determination from the NYSDOL website [www.labor.ny.gov](http://www.labor.ny.gov).

The Commissioner of Labor makes an annual determination of the prevailing rates. This determination is in effect from July 1st through June 30th of the following year. The annual determination is available on the NYSDOL website [www.labor.ny.gov](http://www.labor.ny.gov).

## **Payrolls and Payroll Records**

Every contractor and subcontractor **MUST** keep original payrolls or transcripts subscribed and affirmed as true under penalty of perjury. As per Article 6 of the Labor law, contractors and subcontractors are required to establish, maintain, and preserve for not less than six (6) years, contemporaneous, true, and accurate payroll records. At a minimum, payrolls must show the following information for each person employed on a public work project: Name, Address, Last 4 Digits of Social Security Number, Classification(s) in which the worker was employed, Hourly wage rate(s) paid, Supplements paid or provided, and Daily and weekly number of hours worked in each classification.

The filing of payrolls to the Department of Jurisdiction is a condition of payment. Every contractor and subcontractor shall submit to the Department of Jurisdiction (Contracting Agency), within thirty (30) days after issuance of its first payroll and every thirty (30) days thereafter, a transcript of the original payrolls, subscribed and affirmed as true under penalty of perjury. The Department of Jurisdiction (Contracting Agency) shall collect, review for facial validity, and maintain such payrolls.

In addition, the Commissioner of Labor may require contractors to furnish, with ten (10) days of a request, payroll records sworn to as their validity and accuracy for public work and private work. Payroll records include, but are not limited to time cards, work description sheets, proof that supplements were provided, cancelled payroll checks and payrolls. Failure to provide the requested information within the allotted ten (10) days will result in the withholding of up to 25% of the contract, not to exceed \$100,000.00. If the contractor or subcontractor does not maintain a place of business in New York State and the amount of the contract exceeds \$25,000.00, payroll records and certifications must be kept on the project worksite.

The prime contractor is responsible for any underpayments of prevailing wages or supplements by any subcontractor.

All contractors or their subcontractors shall provide to their subcontractors a copy of the Prevailing Rate Schedule specified in the public work contract as well as any subsequently issued schedules. A failure to provide these schedules by a contractor or subcontractor is a violation of Article 8, Section 220-a of the Labor Law.

All subcontractors engaged by a public work project contractor or its subcontractor, upon receipt of the original schedule and any subsequently issued schedules, shall provide to such contractor a verified statement attesting that the subcontractor has received the Prevailing Rate Schedule and will pay or provide the applicable rates of wages and supplements specified therein. (See NYS Labor Laws, Article 8 . Section 220-a).

### **Determination of Prevailing Wage and Supplement Rate Updates Applicable to All Counties**

The wages and supplements contained in the annual determination become effective July 1st whether or not the new determination has been received by a given contractor. Care should be taken to review the rates for obvious errors. Any corrections should be brought to the Department's attention immediately. It is the responsibility of the public work contractor to use the proper rates. If there is a question on the proper classification to be used, please call the district office located nearest the project. Any errors in the annual determination will be corrected and posted to the NYSDOL website on the first business day of each month. Contractors are responsible for paying these updated rates as well, retroactive to July 1st.

When you review the schedule for a particular occupation, your attention should be directed to the dates above the column of rates. These are the dates for which a given set of rates is effective. To the extent possible, the Department posts rates in its possession that cover periods of time beyond the July 1st to June 30th time frame covered by a particular annual determination. Rates that extend beyond that instant time period are informational ONLY and may be updated in future annual determinations that actually cover the then appropriate July 1st to June 30th time period.

### **Withholding of Payments**

When a complaint is filed with the Commissioner of Labor alleging the failure of a contractor or subcontractor to pay or provide the prevailing wages or supplements, or when the Commissioner of Labor believes that unpaid wages or supplements may be due, payments on the public work contract shall be withheld from the prime contractor in a sufficient amount to satisfy the alleged unpaid wages and supplements, including interest and civil penalty, pending a final determination.

When the Bureau of Public Work finds that a contractor or subcontractor on a public work project failed to pay or provide the requisite prevailing wages or supplements, the Bureau is authorized by Sections 220-b and 235.2 of the Labor Law to so notify the financial officer of the Department of Jurisdiction (Contracting Agency) that awarded the public work contract. Such officer MUST then withhold or cause to be withheld from any payment due the prime contractor on account of such contract the amount indicated by the Bureau as sufficient to satisfy the unpaid wages and supplements, including interest and any civil penalty that may be assessed by the Commissioner of Labor. The withholding continues until there is a final determination of the underpayment by the Commissioner of Labor or by the court in the event a legal proceeding is instituted for review of the determination of the Commissioner of Labor.

The Department of Jurisdiction (Contracting Agency) shall comply with this order of the Commissioner of Labor or of the court with respect to the release of the funds so withheld.

### **Summary of Notice Posting Requirements**

The current Prevailing Rate Schedule must be posted in a prominent and accessible place on the site of the public work project. The prevailing wage schedule must be encased in, or constructed of, materials capable of withstanding adverse weather conditions and be titled "PREVAILING RATE OF WAGES" in letters no smaller than two (2) inches by two (2) inches.

The "[Public Work Project](#)" notice must be posted at the beginning of the performance of every public work contract, on each job site.



Every employer providing workers. compensation insurance and disability benefits must post notices of such coverage in the format prescribed by the Workers. Compensation Board in a conspicuous place on the jobsite.

Every employer subject to the NYS Human Rights Law must conspicuously post at its offices, places of employment, or employment training centers, notices furnished by the State Division of Human Rights.

Employers liable for contributions under the Unemployment Insurance Law must conspicuously post on the jobsite notices furnished by the NYS Department of Labor.

## **Apprentices**

Employees cannot be paid apprentice rates unless they are individually registered in a program registered with the NYS Commissioner of Labor. The allowable ratio of apprentices to journeyworkers in any craft classification can be no greater than the statewide building trade ratios promulgated by the Department of Labor and included with the Prevailing Rate Schedule. An employee listed on a payroll as an apprentice who is not registered as above or is performing work outside the classification of work for which the apprentice is indentured, must be paid the prevailing journeyworker's wage rate for the classification of work the employee is actually performing.

NYSDOL Labor Law, Article 8, Section 220-3, require that only apprentices individually registered with the NYS Department of Labor may be paid apprenticeship rates on a public work project. No other Federal or State Agency of office registers apprentices in New York State.

Persons wishing to verify the apprentice registration of any person must do so in writing by mail, to the NYSDOL Office of Employability Development / Apprenticeship Training, State Office Bldg. Campus, Bldg. 12, Albany, NY 12226 or by Fax to NYSDOL Apprenticeship Training (518) 457-7154. All requests for verification must include the name and social security number of the person for whom the information is requested.

The only conclusive proof of individual apprentice registration is written verification from the NYSDOL Apprenticeship Training Albany Central office. Neither Federal nor State Apprenticeship Training offices outside of Albany can provide conclusive registration information.

It should be noted that the existence of a registered apprenticeship program is not conclusive proof that any person is registered in that program. Furthermore, the existence or possession of wallet cards, identification cards, or copies of state forms is not conclusive proof of the registration of any person as an apprentice.

## **Interest and Penalties**

In the event that an underpayment of wages and/or supplements is found:

- Interest shall be assessed at the rate then in effect as prescribed by the Superintendent of Banks pursuant to section 14-a of the Banking Law, per annum from the date of underpayment to the date restitution is made.
- A Civil Penalty may also be assessed, not to exceed 25% of the total of wages, supplements, and interest due.

## **Debarment**

Any contractor or subcontractor and/or its successor shall be ineligible to submit a bid on or be awarded any public work contract or subcontract with any state, municipal corporation or public body for a period of five (5) years when:

- Two (2) willful determinations have been rendered against that contractor or subcontractor and/or its successor within any consecutive six (6) year period.
- There is any willful determination that involves the falsification of payroll records or the kickback of wages or supplements.

## **Criminal Sanctions**

Willful violations of the Prevailing Wage Law (Article 8 of the Labor Law) may be a felony punishable by fine or imprisonment of up to 15 years, or both.

## **Discrimination**

No employee or applicant for employment may be discriminated against on account of age, race, creed, color, national origin, sex, disability or marital status.

No contractor, subcontractor nor any person acting on its behalf, shall by reason of race, creed, color, disability, sex or national origin discriminate against any citizen of the State of New York who is qualified and available to perform the work to which the employment relates (NYS Labor Law, Article 8, Section 220-e(a)).

No contractor, subcontractor, nor any person acting on its behalf, shall in any manner, discriminate against or intimidate any employee on account of race, creed, color, disability, sex, or national origin (NYS Labor Law, Article 8, Section 220-e(b)).

The Human Rights Law also prohibits discrimination in employment because of age, marital status, or religion.

There may be deducted from the amount payable to the contractor under the contract a penalty of \$50.00 for each calendar day during which such person was discriminated against or intimidated in violation of the provision of the contract (NYS Labor Law, Article 8, Section 220-e(c) ).

The contract may be cancelled or terminated by the State or municipality. All monies due or to become due thereunder may be forfeited for a second or any subsequent violation of the terms or conditions of the anti-discrimination sections of the contract (NYS Labor Law, Article 8, Section 220-e(d) ).

Every employer subject to the New York State Human Rights Law must conspicuously post at its offices, places of employment, or employment training centers notices furnished by the State Division of Human Rights.

### **Workers' Compensation**

In accordance with Section 142 of the State Finance Law, the contractor shall maintain coverage during the life of the contract for the benefit of such employees as required by the provisions of the New York State Workers' Compensation Law.

A contractor who is awarded a public work contract must provide proof of workers' compensation coverage prior to being allowed to begin work.

The insurance policy must be issued by a company authorized to provide workers' compensation coverage in New York State. Proof of coverage must be on form C-105.2 (Certificate of Workers' Compensation Insurance) and must name this agency as a certificate holder.

If New York State coverage is added to an existing out-of-state policy, it can only be added to a policy from a company authorized to write workers' compensation coverage in this state. The coverage must be listed under item 3A of the information page.

The contractor must maintain proof that subcontractors doing work covered under this contract secured and maintained a workers' compensation policy for all employees working in New York State.

Every employer providing worker's compensation insurance and disability benefits must post notices of such coverage in the format prescribed by the Workers' Compensation Board in a conspicuous place on the jobsite.

### **Unemployment Insurance**

Employers liable for contributions under the Unemployment Insurance Law must conspicuously post on the jobsite notices furnished by the New York State Department of Labor.



Kathy Hochul, Governor

Roberta Reardon, Commissioner

City of Rye DPW  
Eric Kingsbury  
141 Oakland Beach Avenue  
Rye NY 10580

Schedule Year 2024 through 2025  
Date Requested 09/23/2024  
PRC# 2024012100

Location City of Rye  
Project ID# 2024-10  
Project Type Project consists of the demolition of an existing DPW garage building and the construction of a new, multiuse, garage and administrative office building. Also new electrical service and solar power

### Notice of Contract Award

New York State Labor Law, Article 8, Section 220.3a requires that certain information regarding the awarding of public work contracts, be furnished to the Commissioner of Labor. One "Notice of Contract Award" (PW 16, which may be photocopied), **MUST** be completed for **EACH** prime contractor on the above referenced project.

Upon notifying the successful bidder(s) of this contract, enter the required information and mail **OR** fax this form to the office shown at the bottom of this notice, **OR** fill out the electronic version via the NYSDOL website.

### Contractor Information

All information must be supplied

Federal Employer Identification Number: _____		
Name: _____		
Address: _____ _____		
City: _____	State: _____	Zip: _____
Amount of Contract: \$ _____	Contract Type:	
Approximate Starting Date: ____/____/____	<input type="checkbox"/> (01) General Construction	
Approximate Completion Date: ____/____/____	<input type="checkbox"/> (02) Heating/Ventilation	
	<input type="checkbox"/> (03) Electrical	
	<input type="checkbox"/> (04) Plumbing	
	<input type="checkbox"/> (05) Other : _____	

Phone: (518) 457-5589 Fax: (518) 485-1870  
W. Averell Harriman State Office Campus, Bldg. 12, Room 130, Albany, NY 12226



### **Social Security Numbers on Certified Payrolls:**

The Department of Labor is cognizant of the concerns of the potential for misuse or inadvertent disclosure of social security numbers. Identity theft is a growing problem and we are sympathetic to contractors' concern regarding inclusion of this information on payrolls if another identifier will suffice.

For these reasons, the substitution of the use of the last four digits of the social security number on certified payrolls submitted to contracting agencies on public work projects is now acceptable to the Department of Labor. This change does not affect the Department's ability to request and receive the entire social security number from employers during its public work/ prevailing wage investigations.

### **Construction Industry Fair Play Act: Required Posting for Labor Law Article 25-B § 861-d**

Construction industry employers must post the "Construction Industry Fair Play Act" notice in a prominent and accessible place on the job site. Failure to post the notice can result in penalties of up to \$1,500 for a first offense and up to \$5,000 for a second offense. The posting is included as part of this wage schedule. Additional copies may be obtained from the NYS DOL website, <https://dol.ny.gov/public-work-and-prevailing-wage>

If you have any questions concerning the Fair Play Act, please call the State Labor Department toll-free at 1-866-435-1499 or email us at: [dol.misclassified@labor.ny.gov](mailto:dol.misclassified@labor.ny.gov) .

### **Worker Notification: (Labor Law §220, paragraph a of subdivision 3-a)**

#### **Effective June 23, 2020**

This provision is an addition to the existing wage rate law, Labor Law §220, paragraph a of subdivision 3-a. It requires contractors and subcontractors to provide written notice to all laborers, workers or mechanics of the *prevailing wage and supplement rate* for their particular job classification *on each pay stub*\*. It also requires contractors and subcontractors to *post a notice* at the beginning of the performance of every public work contract *on each job site* that includes the telephone number and address for the Department of Labor and a statement informing laborers, workers or mechanics of their right to contact the Department of Labor if he/she is not receiving the proper prevailing rate of wages and/or supplements for his/her job classification. The required notification will be provided with each wage schedule, may be downloaded from our website [www.labor.ny.gov](http://www.labor.ny.gov) or be made available upon request by contacting the Bureau of Public Work at 518-457-5589. \*In the event the required information will not fit on the pay stub, an accompanying sheet or attachment of the information will suffice.

**To all State Departments, Agency Heads and Public Benefit Corporations  
IMPORTANT NOTICE REGARDING PUBLIC WORK ENFORCEMENT FUND**

**Budget Policy & Reporting Manual**

**B-610**

**Public Work Enforcement Fund**

*effective date December 7, 2005*

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**1. Purpose and Scope:**

This Item describes the Public Work Enforcement Fund (the Fund, PWEF) and its relevance to State agencies and public benefit corporations engaged in construction or reconstruction contracts, maintenance and repair, and announces the recently-enacted increase to the percentage of the dollar value of such contracts that must be deposited into the Fund. This item also describes the roles of the following entities with respect to the Fund:

- New York State Department of Labor (DOL),
- The Office of the State of Comptroller (OSC), and
- State agencies and public benefit corporations.

**2. Background and Statutory References:**

DOL uses the Fund to enforce the State's Labor Law as it relates to contracts for construction or reconstruction, maintenance and repair, as defined in subdivision two of Section 220 of the Labor Law. State agencies and public benefit corporations participating in such contracts are required to make payments to the Fund.

Chapter 511 of the Laws of 1995 (as amended by Chapter 513 of the Laws of 1997, Chapter 655 of the Laws of 1999, Chapter 376 of the Laws of 2003 and Chapter 407 of the Laws of 2005) established the Fund.

**3. Procedures and Agency Responsibilities:**

The Fund is supported by transfers and deposits based on the value of contracts for construction and reconstruction, maintenance and repair, as defined in subdivision two of Section 220 of the Labor Law, into which all State agencies and public benefit corporations enter.

Chapter 407 of the Laws of 2005 increased the amount required to be provided to this fund to .10 of one-percent of the total cost of each such contract, to be calculated at the time agencies or public benefit corporations enter into a new contract or if a contract is amended. The provisions of this bill became effective August 2, 2005.

**To all State Departments, Agency Heads and Public Benefit Corporations**  
**IMPORTANT NOTICE REGARDING PUBLIC WORK ENFORCEMENT FUND**

OSC will report to DOL on all construction-related ("D") contracts approved during the month, including contract amendments, and then DOL will bill agencies the appropriate assessment monthly. An agency may then make a determination if any of the billed contracts are exempt and so note on the bill submitted back to DOL. For any instance where an agency is unsure if a contract is or is not exempt, they can call the Bureau of Public Work at the number noted below for a determination. Payment by check or journal voucher is due to DOL within thirty days from the date of the billing. DOL will verify the amounts and forward them to OSC for processing.

For those contracts which are not approved or administered by the Comptroller, monthly reports and payments for deposit into the Public Work Enforcement Fund must be provided to the Administrative Finance Bureau at the DOL within 30 days of the end of each month or on a payment schedule mutually agreed upon with DOL.

Reports should contain the following information:

- Name and billing address of State agency or public benefit corporation;
- State agency or public benefit corporation contact and phone number;
- Name and address of contractor receiving the award;
- Contract number and effective dates;
- Contract amount and PWEF assessment charge (if contract amount has been amended, reflect increase or decrease to original contract and the adjustment in the PWEF charge); and
- Brief description of the work to be performed under each contract.

Checks and Journal Vouchers, payable to the "New York State Department of Labor" should be sent to:

Department of Labor  
Administrative Finance Bureau-PWEF Unit  
Building 12, Room 464  
State Office Campus  
Albany, NY 12226

Any questions regarding billing should be directed to NYSDOL's Administrative Finance Bureau-PWEF Unit at (518) 457-3624 and any questions regarding Public Work Contracts should be directed to the Bureau of Public Work at (518) 457-5589.





Required Notice under Article 25-B of the Labor Law

**Attention All Employees, Contractors and Subcontractors:  
You are Covered by the Construction Industry Fair Play Act**

**The law says that you are an employee unless:**

- You are free from direction and control in performing your job, **and**
- You perform work that is not part of the usual work done by the business that hired you, **and**
- You have an independently established business.

Your employer cannot consider you to be an independent contractor unless all three of these facts apply to your work.

**It is against the law for an employer to misclassify employees as independent contractors or pay employees off the books.**

**Employee Rights:** If you are an employee, you are entitled to state and federal worker protections. These include:

- Unemployment Insurance benefits, if you are unemployed through no fault of your own, able to work, and otherwise qualified,
- Workers' compensation benefits for on-the-job injuries,
- Payment for wages earned, minimum wage, and overtime (under certain conditions),
- Prevailing wages on public work projects,
- The provisions of the National Labor Relations Act, and
- A safe work environment.

It is a violation of this law for employers to retaliate against anyone who asserts their rights under the law. Retaliation subjects an employer to civil penalties, a private lawsuit or both.

**Independent Contractors:** If you are an independent contractor, **you must pay all taxes and Unemployment Insurance contributions required by New York State and Federal Law.**

**Penalties** for paying workers off the books or improperly treating employees as independent contractors:

- **Civil Penalty**
  - First offense: Up to \$2,500 per employee
  - Subsequent offense(s): Up to \$5,000 per employee
- **Criminal Penalty**
  - First offense: Misdemeanor - up to 30 days in jail, up to a \$25,000 fine and debarment from performing public work for up to one year.
  - Subsequent offense(s): Misdemeanor - up to 60 days in jail or up to a \$50,000 fine and debarment from performing public work for up to 5 years.

**If you have questions about your employment status or believe that your employer may have violated your rights and you want to file a complaint, call the Department of Labor at (866) 435-1499 or send an email to [dol.misclassified@labor.ny.gov](mailto:dol.misclassified@labor.ny.gov). All complaints of fraud and violations are taken seriously. You can remain anonymous.**

**Employer Name:**

IA 999 (09/16)





# Attention Employees

## THIS IS A: **PUBLIC WORK PROJECT**

If you are employed on this project as a **worker, laborer, or mechanic** you are entitled to receive the **prevailing wage and supplements rate** for the classification at which you are working.

Your pay stub and wage notice received upon hire must clearly state your wage rate and supplement rate.

Chapter 629 of  
the Labor Laws  
of 2007:

**These wages are set by law and must be posted at the work site. They can also be found at:**  
**<https://dol.ny.gov/bureau-public-work>**



If you feel that you have not received proper wages or benefits, please call our nearest office.\*

Albany	(518) 457-2744	Patchogue	(631) 687-4882
Binghamton	(607) 721-8005	Rochester	(585) 258-4505
Buffalo	(716) 847-7159	Syracuse	(315) 428-4056
Garden City	(516) 228-3915	Utica	(315) 793-2314
New York City	(212) 932-2419	White Plains	(914) 997-9507
Newburgh	(845) 568-5287		

\* For New York City government agency construction projects, please contact the Office of the NYC Comptroller at (212) 669-4443, or [www.comptroller.nyc.gov](http://www.comptroller.nyc.gov) – click on Bureau of Labor Law.

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

Project Location: \_\_\_\_\_



## Requirements for OSHA 10 Compliance

Article 8 §220-h requires that when the advertised specifications, for every contract for public work, is \$250,000.00 or more the contract must contain a provision requiring that every worker employed in the performance of a public work contract shall be certified as having completed an OSHA 10 safety training course. The clear intent of this provision is to require that all employees of public work contractors, required to be paid prevailing rates, receive such training "prior to the performing any work on the project."

### The Bureau will enforce the statute as follows:

All contractors and sub contractors must attach a copy of proof of completion of the OSHA 10 course to the first certified payroll submitted to the contracting agency and on each succeeding payroll where any new or additional employee is first listed.

Proof of completion may include but is not limited to:

- Copies of bona fide course completion card (*Note: Completion cards do not have an expiration date.*)
- Training roster, attendance record or other documentation from the certified trainer pending the issuance of the card.
- Other valid proof

\*\*A certification by the employer attesting that all employees have completed such a course is not sufficient proof that the course has been completed.

Any questions regarding this statute may be directed to the New York State Department of Labor, Bureau of Public Work at 518-457-5589.

## WICKS

Public work projects are subject to the Wicks Law requiring separate specifications and bidding for the plumbing, heating and electrical work, when the total project's threshold is \$3 million in Bronx, Kings, New York, Queens and, Richmond counties; \$1.5 million in Nassau, Suffolk and Westchester counties; and \$500,000 in all other counties.

For projects below the monetary threshold, bidders must submit a sealed list naming each subcontractor for the plumbing, HVAC and electrical and the amount to be paid to each. The list may not be changed unless the public owner finds a legitimate construction need, including a change in specifications or costs or the use of a Project Labor Agreement (PLA), and must be open to public inspection.

Allows the state and local agencies and authorities to waive the Wicks Law and use a PLA if it will provide the best work at the lowest possible price. If a PLA is used, all contractors shall participate in apprentice training programs in the trades of work it employs that have been approved by the Department of Labor (DOL) for not less than three years. They shall also have at least one graduate in the last three years and use affirmative efforts to retain minority apprentices. PLA's would be exempt from Wicks, but deemed to be public work subject to prevailing wage enforcement.

The Commissioner of Labor shall have the power to enforce separate specification requirements on projects, and may issue stop-bid orders against public owners for non-compliance.

Other new monetary thresholds, and similar sealed bidding for non-Wicks projects, would apply to certain public authorities including municipal housing authorities, NYC Construction Fund, Yonkers Educational Construction Fund, NYC Municipal Water Finance Authority, Buffalo Municipal Water Finance Authority, Westchester County Health Care Association, Nassau County Health Care Corp., Clifton-Fine Health Care Corp., Erie County Medical Center Corp., NYC Solid Waste Management Facilities, and the Dormitory Authority.

Contractors must pay subcontractors within a 7 days period.

(07.19)

## Introduction to the Prevailing Rate Schedule

### Information About Prevailing Rate Schedule

This information is provided to assist you in the interpretation of particular requirements for each classification of worker contained in the attached Schedule of Prevailing Rates.

#### Classification

It is the duty of the Commissioner of Labor to make the proper classification of workers taking into account whether the work is heavy and highway, building, sewer and water, tunnel work, or residential, and to make a determination of wages and supplements to be paid or provided. It is the responsibility of the public work contractor to use the proper rate. If there is a question on the proper classification to be used, please call the district office located nearest the project. District office locations and phone numbers are listed below.

Prevailing Wage Schedules are issued separately for "General Construction Projects" and "Residential Construction Projects" on a county-by-county basis.

General Construction Rates apply to projects such as: Buildings, Heavy & Highway, and Tunnel and Water & Sewer rates.

Residential Construction Rates generally apply to construction, reconstruction, repair, alteration, or demolition of one family, two family, row housing, or rental type units intended for residential use.

Some rates listed in the Residential Construction Rate Schedule have a very limited applicability listed along with the rate. Rates for occupations or locations not shown on the residential schedule must be obtained from the General Construction Rate Schedule. Please contact the local Bureau of Public Work office before using Residential Rate Schedules, to ensure that the project meets the required criteria.

#### Payrolls and Payroll Records

Contractors and subcontractors are required to establish, maintain, and preserve for not less than six (6) years, contemporaneous, true, and accurate payroll records.

Every contractor and subcontractor shall submit to the Department of Jurisdiction (Contracting Agency), within thirty (30) days after issuance of its first payroll and every thirty (30) days thereafter, a transcript of the original payrolls, subscribed and affirmed as true under penalty of perjury.

#### Paid Holidays

Paid Holidays are days for which an eligible employee receives a regular day's pay, but is not required to perform work. If an employee works on a day listed as a paid holiday, this remuneration is in addition to payment of the required prevailing rate for the work actually performed.

#### Overtime

At a minimum, all work performed on a public work project in excess of eight hours in any one day or more than five days in any workweek is overtime. However, the specific overtime requirements for each trade or occupation on a public work project may differ. Specific overtime requirements for each trade or occupation are contained in the prevailing rate schedules.

Overtime holiday pay is the premium pay that is required for work performed on specified holidays. It is only required where the employee actually performs work on such holidays.

The applicable holidays are listed under HOLIDAYS: OVERTIME. The required rate of pay for these covered holidays can be found in the OVERTIME PAY section listings for each classification.

#### Supplemental Benefits

Particular attention should be given to the supplemental benefit requirements. Although in most cases the payment or provision of supplements is straight time for all hours worked, some classifications require the payment or provision of supplements, or a portion of the supplements, to be paid or provided at a premium rate for premium hours worked. Supplements may also be required to be paid or provided on paid holidays, regardless of whether the day is worked. The Overtime Codes and Notes listed on the particular wage classification will indicate these conditions as required.

#### Effective Dates

When you review the schedule for a particular occupation, your attention should be directed to the dates above the column of rates. These are the dates for which a given set of rates is effective. The rate listed is valid until the next effective rate change or until the new annual determination which takes effect on July 1 of each year. All contractors and subcontractors are required to pay the current prevailing rates of wages and supplements. If you have any questions please contact the Bureau of Public Work or visit the New York State Department of Labor website ([www.labor.ny.gov](http://www.labor.ny.gov)) for current wage rate information.

#### Apprentice Training Ratios

The following are the allowable ratios of registered Apprentices to Journey-workers.

For example, the ratio 1:1,1:3 indicates the allowable initial ratio is one Apprentice to one Journeyworker. The Journeyworker must be in place on the project before an Apprentice is allowed. Then three additional Journeyworkers are needed before a second Apprentice is allowed. The last ratio repeats indefinitely. Therefore, three more Journeyworkers must be present before a third Apprentice can be hired, and so on.

Please call Apprentice Training Central Office at (518) 457-6820 if you have any questions.

Title (Trade)	Ratio
Boilermaker (Construction)	1:1,1:4
Boilermaker (Shop)	1:1,1:3
Carpenter (Bldg.,H&H, Pile Driver/Dockbuilder)	1:1,1:4
Carpenter (Residential)	1:1,1:3
Electrical (Outside) Lineman	1:1,1:2
Electrician (Inside)	1:1,1:3
Elevator/Escalator Construction & Modernizer	1:1,1:2
Glazier	1:1,1:3
Insulation & Asbestos Worker	1:1,1:3
Iron Worker	1:1,1:4
Laborer	1:1,1:3
Mason	1:1,1:4
Millwright	1:1,1:4
Op Engineer	1:1,1:5
Painter	1:1,1:3
Plumber & Steamfitter	1:1,1:3
Roofer	1:1,1:2
Sheet Metal Worker	1:1,1:3
Sprinkler Fitter	1:1,1:2

If you have any questions concerning the attached schedule or would like additional information, please contact the nearest BUREAU of PUBLIC WORK District Office or write to:

New York State Department of Labor  
Bureau of Public Work  
State Office Campus, Bldg. 12  
Albany, NY 12226

District Office Locations:	Telephone #	FAX #
Bureau of Public Work - Albany	518-457-2744	518-485-0240
Bureau of Public Work - Binghamton	607-721-8005	607-721-8004
Bureau of Public Work - Buffalo	716-847-7159	716-847-7650
Bureau of Public Work - Garden City	516-228-3915	516-794-3518
Bureau of Public Work - Newburgh	845-568-5287	845-568-5332
Bureau of Public Work - New York City	212-932-2419	212-775-3579
Bureau of Public Work - Patchogue	631-687-4882	631-687-4902
Bureau of Public Work - Rochester	585-258-4505	585-258-4708
Bureau of Public Work - Syracuse	315-428-4056	315-428-4671
Bureau of Public Work - Utica	315-793-2314	315-793-2514
Bureau of Public Work - White Plains	914-997-9507	914-997-9523
Bureau of Public Work - Central Office	518-457-5589	518-485-1870

Westchester County General Construction

Boilermaker	09/01/2024
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JOB DESCRIPTION BoilermakerDISTRICT 4

ENTIRE COUNTIES  
Bronx, Dutchess, Kings, Nassau, New York, Orange, Putnam, Queens, Richmond, Rockland, Suffolk, Sullivan, Ulster, Westchester

WAGES		
Per Hour:	07/01/2024	01/01/2025
Boilermaker	\$ 67.38	\$ 68.88
Repairs & Renovations	67.38	68.88

Repairs & Renovation: Includes Repairing, Renovating replacement of parts to an existing unit(s).

SUPPLEMENTAL BENEFITS		
Per Hour:		
Boilermaker	33.5% of hourly	33.5% of Hourly
Repair & Renovations	Wage Paid	Wage Paid
	+ \$ 26.85	+ \$26.85

NOTE: "Hourly Wage Paid" shall include any and all premium(s) pay.

Repairs & Renovation Includes replacement of parts and repairs & renovation of existing unit.

OVERTIME PAY  
See (\*B, O, \*\*U) on OVERTIME PAGE  
Note:\* Includes 9th & 10th hours, double for 11th or more.  
\*\* Labor Day ONLY, if worked.

Repairs & Renovation see (B,E,Q) on OT Page

HOLIDAY  
Paid: See (1) on HOLIDAY PAGE  
Overtime: See (5, 6, 11, 12, 15, 25, 26, 29) on HOLIDAY PAGE

REGISTERED APPRENTICES  
Wage per hour:  
(1/2) Year Terms at the following percentage of Boilermaker's Wage

1st	2nd	3rd	4th	5th	6th	7th
65%	70%	75%	80%	85%	90%	95%

Supplemental Benefits Per Hour:		
	33.5% of Hourly Wage Paid Plus Amount Below	33.5% of Hourly Wage Paid Plus Amount Below
1st Term	\$ 20.36	\$ 20.36
2nd Term	21.28	21.28
3rd Term	22.22	22.22
4th Term	23.12	23.12
5th Term	24.07	24.07
6th Term	25.00	25.00
7th Term	25.93	25.93

NOTE: "Hourly Wage Paid" shall include any and all premium(s)

4-5

Carpenter	09/01/2024
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JOB DESCRIPTION CarpenterDISTRICT 8

ENTIRE COUNTIES  
Bronx, Kings, Nassau, New York, Putnam, Queens, Richmond, Rockland, Suffolk, Westchester

WAGES	
Per hour:	07/01/2024



Piledriver	\$ 60.59 + 10.00*
Dockbuilder	\$ 60.59 + 10.00*

\*This portion of the benefit is NOT subject to the SAME PREMIUM as shown for overtime.

#### **SUPPLEMENTAL BENEFITS**

Per hour:

Journeyworker	\$ 45.79
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#### **OVERTIME PAY**

See (B, E2, O) on OVERTIME PAGE

#### **HOLIDAY**

Paid: See (1) on HOLIDAY PAGE.

Paid: for 1st & 2nd yr.

Apprentices See (5,6,11,13,25)

Overtime: See (5,6,11,13,25) on HOLIDAY PAGE.

#### **REGISTERED APPRENTICES**

Wages per hour

(1)year terms:

1st	2nd	3rd	4th
\$26.98	\$32.58	\$40.96	\$49.35
+ 5.50*	+ 5.50*	+ 5.50*	+ 5.50*

\*This portion of the benefit is NOT subject to the SAME PREMIUM as shown for overtime.

Supplemental benefits per hour:

All Terms: \$ 32.34

8-1556 Db

### **Carpenter**

09/01/2024

**JOB DESCRIPTION** Carpenter

**DISTRICT** 8

#### **ENTIRE COUNTIES**

Bronx, Kings, Nassau, New York, Queens, Richmond, Rockland, Suffolk, Westchester

#### **WAGES**

Per hour: 07/01/2024

Carpet/Resilient

Floor Coverer \$ 55.05  
+ 8.25\*

\*This portion of the benefit is NOT subject to the SAME PREMIUM as shown for overtime.

INCLUDES HANDLING & INSTALLATION OF ARTIFICIAL TURF AND SIMILAR TURF INDOORS/OUTDOORS.

#### **SUPPLEMENTAL BENEFITS**

Per hour:

\$ 39.45

#### **OVERTIME PAY**

See (B, E, Q) on OVERTIME PAGE

#### **HOLIDAY**

Paid: See (18, 19) on HOLIDAY PAGE.

Paid for 1st & 2nd yr.

Apprentices See (5,6,11,13,16,18,19,25)

Overtime: See (5,6,11,13,16,18,19,25) on HOLIDAY PAGE.

#### **REGISTERED APPRENTICES**

Wage per hour - (1) year terms:

1st	2nd	3rd	4th
\$ 25.20	\$ 28.20	\$ 32.45	\$ 40.33

+ 1.85\*      + 2.35\*      + 2.85\*      + 3.85\*

\*This portion of the benefit is NOT subject to the SAME PREMIUM as shown for overtime.

Supplemental benefits per hour:

1st	2nd	3rd	4th
\$ 15.22	\$ 16.22	\$ 19.32	\$ 20.32

8-2287

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**Carpenter****09/01/2024**

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**JOB DESCRIPTION** Carpenter

**DISTRICT** 8

**ENTIRE COUNTIES**

Bronx, Dutchess, Kings, Nassau, New York, Orange, Putnam, Queens, Richmond, Rockland, Suffolk, Westchester

**WAGES**

Per Hour: 07/01/2024

Marine Construction:

Marine Diver               \$ 75.46  
+ 10.00\*

Marine Tender             \$ 55.00  
+ 10.00\*

\*This portion of the benefit is NOT subject to the SAME PREMIUM as shown for overtime

**SUPPLEMENTAL BENEFITS**

Per Hour:

Journeyworker             \$ 45.65

**OVERTIME PAY**

See (B, E, E2, Q) on OVERTIME PAGE

**HOLIDAY**

Paid: See (18, 19) on HOLIDAY PAGE

Overtime: See (5, 6, 11, 13, 16, 18, 19, 25) on HOLIDAY PAGE

**REGISTERED APPRENTICES**

Wages per hour:

One (1) year terms.

1st year	\$ 26.98 + 5.50*
2nd year	32.58 + 5.50*
3rd year	40.96 + 5.50*
4th year	49.35 + 5.50*

\*This portion of the benefit is NOT subject to the SAME PREMIUM as shown for overtime.

Supplemental Benefits

Per Hour:

All terms                   \$ 32.20

8-1456MC

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**Carpenter****09/01/2024**

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**JOB DESCRIPTION** Carpenter

**DISTRICT** 8

**ENTIRE COUNTIES**

Bronx, Kings, Nassau, New York, Putnam, Queens, Richmond, Rockland, Suffolk, Westchester

**WAGES**

Per hour: 07/01/2024

Building  
Millwright                      \$ 59.35  
   + 13.12\*

\*This portion of the benefit is NOT subject to the SAME PREMIUM as shown for overtime.

**SUPPLEMENTAL BENEFITS**

Per hour:

Millwright                      \$ 45.41

**OVERTIME PAY**

See (B, E, Q) on OVERTIME PAGE

**HOLIDAY**

Paid:                              See (18, 19) on HOLIDAY PAGE

Paid:                              See (18,19) on HOLIDAY PAGE.

Overtime                      See (5,6,8,11,13,18,19,25) on HOLIDAY PAGE.

**REGISTERED APPRENTICES**

Wages per hour:

One (1) year terms:

1st.	2nd.	3rd.	4th.
\$ 32.16	\$ 37.61	\$ 43.06	\$ 53.96
+ 7.08*	+ 8.25*	+ 9.42*	+ 11.76*

\*This portion of the benefit is NOT subject to the SAME PREMIUM as shown for overtime.

Supplemental benefits per hour:

One (1) year terms:

1st.	2nd.	3rd.	4th.
\$ 30.56	\$ 33.09	\$ 36.27	\$ 40.69

8-740.1

**Carpenter**

**09/01/2024**

**JOB DESCRIPTION** Carpenter

**DISTRICT 8**

**ENTIRE COUNTIES**

Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk, Westchester

**WAGES**

Per Hour:

07/01/2024

Timberman                      \$ 55.59  
   + 10.26\*

\*This portion of the benefit is NOT subject to the SAME PREMIUM as shown for overtime.

**SUPPLEMENTAL BENEFITS**

Per Hour:

07/01/2024

\$ 44.96

**OVERTIME PAY**

See (B, E, E2, Q) on OVERTIME PAGE

**HOLIDAY**

Overtime:                      See (5, 6, 11, 13, 25) on HOLIDAY PAGE

Paid:                              See (1) on HOLIDAY PAGE.

Paid: for 1st & 2nd yr.

Apprentices                      See (5,6,11,13,25)

Overtime:                      See (5,6,11,13,25) on HOLIDAY PAGE.

**REGISTERED APPRENTICES**

Wages per hour:

One ( 1 ) year terms:

1st	2nd	3rd	4th
-----	-----	-----	-----

\$24.96	\$30.07	\$37.72	\$45.38
+ 5.55*	+ 5.55*	+ 5.55*	+ 5.55*

\*This portion of the benefit is NOT subject to the SAME PREMIUM as shown for overtime.

Supplemental benefits per hour:

All terms \$ 31.95

8-1556 Tm

## Carpenter

09/01/2024

**JOB DESCRIPTION** Carpenter

**DISTRICT** 8

### ENTIRE COUNTIES

Bronx, Kings, Nassau, New York, Queens, Richmond, Rockland, Westchester

### PARTIAL COUNTIES

Orange: South of but including the following, Waterloo Mills, Slate Hill, New Hampton, Goshen, Blooming Grove, Mountainville, east to the Hudson River.

Putnam: South of but including the following, Cold Spring, TompkinsCorner, Mahopac, Croton Falls, east to Connecticut border.

Suffolk: West of Port Jefferson and Patchogue Road to Route 112 to the Atlantic Ocean.

### WAGES

Per hour: 07/01/2024

Core Drilling:

Driller \$ 46.25  
+ 3.25\*

Driller Helper \$ 36.28  
+ 3.25\*

Note: Hazardous Waste Pay Differential:

For Level C, an additional 15% above wage rate per hour

For Level B, an additional 15% above wage rate per hour

For Level A, an additional 15% above wage rate per hour

Note: When required to work on water: an additional \$ 3.00 per hour.

\*This portion of the benefit is NOT subject to the SAME PREMIUM as shown for overtime.

### SUPPLEMENTAL BENEFITS

Per hour:

Driller and Helper \$ 30.24

### OVERTIME PAY

See (B, G, P) on OVERTIME PAGE

### HOLIDAY

Paid: See (5, 6) on HOLIDAY PAGE

Overtime: See (5, 6) on HOLIDAY PAGE

8-1536-CoreDriller

## Carpenter - Building / Heavy&Highway

09/01/2024

**JOB DESCRIPTION** Carpenter - Building / Heavy&Highway

**DISTRICT** 11

### ENTIRE COUNTIES

Putnam, Rockland, Westchester

### WAGES

WAGES:(per hour)

Applies to CAPRENTER BUILDING/HEAVY & HIGHWAY/TUNNEL:

	07/01/2024	07/01/2025	07/01/2026
		Additional	Additional
Base Wage	\$ 42.76	\$ 1.25**	\$ 1.25**
	+\$6.62*		

\*For all hours paid straight or premium.

\*\*To be allocated at a later date.

### SHIFT WORK

SHIFT DIFFERENTIAL: When it is mandated by a Government Agency irregular or off shift can be worked. The Carpenter shall receive an additional fifteen percent (15%) of wage plus applicable benefits.

### SUPPLEMENTAL BENEFITS

Per hour:

Journeyworker \$ 31.60

### OVERTIME PAY

See (B, E, Q) on OVERTIME PAGE

### HOLIDAY

BUILDING:

Paid: See ( 1 ) on HOLIDAY PAGE.

Overtime: See ( 5, 6, 16, 25 ) on HOLIDAY PAGE.

- Holidays that fall on Sunday will be observed Monday.

HEAVY&HIGHWAY/TUNNEL:

Paid: See ( 5, 6, 25 ) on HOLIDAY PAGE

Overtime: See ( 5, 6 ) on HOLIDAY PAGE

- Holidays that fall on Sunday will be observed Monday

- Must be employed during the five (5) work days immediately preceding a holiday or during the five (5) work days following the paid holiday to receive holiday pay

- If Employee is entitled to a paid holiday, the Employee is paid the Holiday wage and supplemental benefits whether they work or not. If Employee works the Holiday, the Employee will receive holiday pay (including supplemental benefits), plus the applicable premium wage for working the Holiday. If Employee works in excess of 8 hours on Holiday, then benefits will be paid for any hours in excess of 8 hours.

### REGISTERED APPRENTICES

1 year terms at the following wage rates:

1st	2nd	3rd	4th
\$ 21.38	\$ 25.66	\$ 29.93	\$ 34.21
+3.84*	+3.84*	+3.84*	+3.84*

\*For all hours paid straight or premium

SUPPLEMENTAL BENEFITS per hour:

All terms \$ 16.25

11-279.1B/HH

### Electrician

09/01/2024

**JOB DESCRIPTION** Electrician

**DISTRICT** 9

### ENTIRE COUNTIES

Bronx, Kings, New York, Queens, Richmond, Westchester

### WAGES

Per hour: 07/01/2024

Service Technician \$ 37.40

Service and Maintenance on Alarm and Security Systems.

Maintenance, repair and /or replacement of defective (or damaged) equipment on, but not limited to, Burglar - Fire - Security - CCTV - Card Access - Life Safety Systems and associated devices. (Whether by service contract of T&M by customer request.)

### SUPPLEMENTAL BENEFITS

Per hour:

Journeyworker: \$ 21.85

### OVERTIME PAY

See (B, E, Q) on OVERTIME PAGE

### HOLIDAY

Paid: See (5, 6, 11, 15, 16, 17, 25, 26) on HOLIDAY PAGE

Overtime: See (5, 6, 11, 15, 16, 17, 25, 26) on HOLIDAY PAGE

9-3H

### Electrician

09/01/2024

**JOB DESCRIPTION** Electrician

**DISTRICT** 8

## ENTIRE COUNTIES

Westchester

### WAGES

Per hour:	07/01/2024	04/17/2025
*Electrician/A-Technician	\$ 56.75	\$ 58.75
Teledata	56.75	58.75

\*All new installations of wiring, conduit, junction boxes and light fixtures for projects with a base bid of more than \$325,000. For projects with a base bid of \$325,000 or less, see Maintenance and Repair rates.

Note: On a job where employees are required to work on bridges over navigable waters, transmission towers, light poles, bosun chairs, swinging scaffolds, etc. 40 feet or more above the water or ground or under compressed air, or tunnel projects under construction or where assisted breathing apparatus is required, they will be paid at the rate of time and one-half for such work except on normal pole line or building construction work.

### SUPPLEMENTAL BENEFITS

Per hour:		
Journeyworker	\$ 59.39	\$61.09

### OVERTIME PAY

See (A, G, \*J, P) on OVERTIME PAGE

\*NOTE: Emergency work on Sunday and Holidays is at the time and one-half overtime rate.

### HOLIDAY

Paid:	See (1) on HOLIDAY PAGE
Overtime:	See (5, 6, 8, 11, 15, 16, 25) on HOLIDAY PAGE

### REGISTERED APPRENTICES

(1) year terms at the following wage rates:

	07/01/2024	04/17/2025
1st term	\$ 16.00	\$16.00
2nd term	17.00	17.00
3rd term	19.00	19.00
4th term	21.00	21.00
MIJ 1-12 months	26.50	26.50
MIJ 13-18 months	30.00	30.00

Supplemental Benefits per hour:

	07/01/2024	04/17/2025
1st term	\$ 12.40	\$ 12.72
2nd term	15.07	15.89
3rd term	16.40	17.23
4th term	17.73	18.57
MIJ 1-12 months	15.72	15.89
MIJ 13-18 months	16.17	16.29

8-3/W

## Electrician

09/01/2024

**JOB DESCRIPTION** Electrician

**DISTRICT** 8

## ENTIRE COUNTIES

Westchester

### WAGES

Per hour	07/01/2024	04/17/2025
Electrician -M	\$ 30.00	\$ 30.00
H - Telephone	30.00	30.00

All work with a base bid amount of \$325,000 or less. Including repairs and /or replacement of defective electrical and teledata equipment, all work necessary to retrofit, service, maintain and repair all kinds of lighting fixtures and local lighting controls, and washing and cleaning of foregoing fixtures.

\*If the project exceeds \$375,000 due to changes in the scope of work, an Electrician/A Technician must be part of the labor ratio.

### SUPPLEMENTAL BENEFITS

	07/01/2024	04/17/2025
Electrician &		
H - Telephone	\$ 16.17	\$ 16.29

### OVERTIME PAY

See (B, G, \*J, P) on OVERTIME PAGE

\*Note: Emergency work on Sunday and Holidays is at the time and one-half overtime rate.

### HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6, 8, 11, 15, 16, 25) on HOLIDAY PAGE

8-3m

## Elevator Constructor

09/01/2024

**JOB DESCRIPTION** Elevator Constructor

**DISTRICT 4**

### ENTIRE COUNTIES

Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk

### PARTIAL COUNTIES

Rockland: Entire County except for the Township of Stony Point

Westchester: Entire County except for the Townships of Bedford, Lewisboro, Cortland, Mt. Kisco, North Salem, Pound Ridge, Somers and Yorktown.

### WAGES

Per hour:

	07/01/2024	03/17/2025
Elevator Constructor	\$ 80.35	\$ 83.37
Modernization & Service/Repair	63.16	65.54

### SUPPLEMENTAL BENEFITS

Per Hour:

Elevator Constructor	\$ 46.367	\$ 47.654
Modernization & Service/Repairs	45.217	46.470

### OVERTIME PAY

Constructor See ( D, M, T ) on OVERTIME PAGE.

Modern/Service See ( B, F, S ) on OVERTIME PAGE.

### HOLIDAY

Paid: See (5, 6, 8, 11, 15, 16, 25) on HOLIDAY PAGE

Overtime: See (5, 6, 8, 11, 15, 16, 25) on HOLIDAY PAGE

### REGISTERED APPRENTICES

WAGES PER HOUR:

6 MONTH TERMS:

1st Term*	2nd & 3rd Term*	4th & 5th Term	6th & 7th Term	8th & 9th Term
50%	50%	55%	65%	75%

\* Note: 1st, 2nd, 3rd Terms are based on Average wage of Constructor, Modernization & Service.  
Terms 4 thru 9 Based on Journeyman's wage of classification Working in.

### SUPPLEMENTAL BENEFITS:

	07/01/2024	03/17/2025
Elevator Constructor		
1st Term	\$ 0.00	\$ 0.00
2nd & 3rd Term	36.15	36.90
4th & 5th Term	37.19	37.99
6th & 7th Term	38.80	39.70
8th & 9th Term	40.41	41.40
Modernization & Service/Repair		
1st Term	\$ 0.00	\$ 0.00
2nd & 3rd Term	36.15	36.90
4th & 5th Term	37.19	37.99
6th & 7th Term	38.80	39.70

8th & 9th Term	40.41	41.40	4-1
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<b>Elevator Constructor</b>	<b>09/01/2024</b>
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**JOB DESCRIPTION** Elevator Constructor

**DISTRICT 1**

**ENTIRE COUNTIES**

Columbia, Dutchess, Greene, Orange, Putnam, Sullivan, Ulster

**PARTIAL COUNTIES**

Delaware: Towns of Andes, Bovina, Colchester, Davenport, Delhi, Harpersfield, Hemdon, Kortright, Meredith, Middletown, Roxbury, Hancock & Stamford

Rockland: Only the Township of Stony Point.

Westchester: Only the Townships of Bedford, Lewisboro, Cortland, Mt. Kisco, North Salem, Pound Ridge, Somers and Yorktown.

**WAGES**

Per Hour	07/01/2024	01/01/2025
Mechanic	\$ 70.15	\$ 73.07
Helper	70% of Mechanic Wage Rate	70% of Mechanic Wage Rate

**SUPPLEMENTAL BENEFITS**

Per hour	07/01/2024	01/01/2025
Journeyworker/Helper	\$ 37.885*	\$ 38.435*

(\*)Plus 6% of regular hourly if less than 5 years of service. Plus 8% of regular hourly rate if more than 5 years of service.

**OVERTIME PAY**

See (D, O) on OVERTIME PAGE

**HOLIDAY**

Paid: See (5, 6, 15, 16) on HOLIDAY PAGE

Overtime: See (5, 6, 15, 16) on HOLIDAY PAGE

Note: When a paid holiday falls on Saturday, it shall be observed on Friday. When a paid holiday falls on Sunday, it shall be observed on Monday.

**REGISTERED APPRENTICES**

Wages per hour:

0-6 mo*	6-12 mo	2nd yr	3rd yr	4th yr
50 %	55 %	65 %	70 %	80 %

(\*)Plus 6% of the hourly rate, no additional supplemental benefits.

Supplemental Benefits per hour worked:

Same as Journeyperson/Helper

1-138

<b>Glazier</b>	<b>09/01/2024</b>
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**JOB DESCRIPTION** Glazier

**DISTRICT 8**

**ENTIRE COUNTIES**

Bronx, Dutchess, Kings, Nassau, New York, Orange, Putnam, Queens, Richmond, Rockland, Suffolk, Sullivan, Ulster, Westchester

**WAGES**

Per hour:	07/01/2024	05/01/2025
Glazier, Glass Tinting and Window Film	\$ 63.28	Additional \$ 1.11***
Scaffolding, including swing scaffold	67.28	
*Mechanical Equipment	64.28	
**Repair & Maintenance	30.76	

\*Mechanical equipment, scissor jacks, man lifts, booms & buckets 30' or more, but not pipe scaffolding.

\*\*Repair & Maintenance- All repair & maintenance work on a particular building whenever performed, where the total cumulative Repair & Maintenance contract value is under \$193,000.



\*\*\*To be allocated at a later date.

### SUPPLEMENTAL BENEFITS

Per hour: 7/01/2024

Glazier, Glass Tinting \$ 42.13

Window Film, Scaffolding  
and Mechanical Equipment

Repair & Maintenance 24.62

### OVERTIME PAY

See (B, E, Q, V) on OVERTIME PAGE

For 'Repair & Maintenance' see (B, B2, I, S) on overtime page.

### HOLIDAY

Paid: See (5, 6, 16, 25) on HOLIDAY PAGE

Overtime: See (5, 6, 16, 25) on HOLIDAY PAGE

For 'Repair & Maintenance'

Paid: See(5, 6, 16, 25)

Overtime: See(5, 6, 16, 25)

### REGISTERED APPRENTICES

Wage per hour:

(1) year terms at the following wage rates:

7/01/2024

1st term \$ 22.34

2nd term 30.64

3rd term 40.87

4th term 50.14

Supplemental Benefits:

(Per hour)

1st term \$ 19.27

2nd term 27.34

3rd term 32.85

4th term 36.01

8-1087 (DC9 NYC)

### Insulator - Heat & Frost

09/01/2024

**JOB DESCRIPTION** Insulator - Heat & Frost

**DISTRICT** 4

### ENTIRE COUNTIES

Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk, Westchester

### WAGES

Per Hour: 07/01/2024

Insulators

Heat & Frost \$ 71.01

### SUPPLEMENTAL BENEFITS

Per Hour:

Insulators \$ 36.76

Heat & Frost

### OVERTIME PAY

See (B, E, \*Q, V) on OVERTIME PAGE

\* Triple time for Labor Day (If worked)

### HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6, 11, 15, 16, 25, 26) on HOLIDAY PAGE

### REGISTERED APPRENTICES

Wages:

1 year terms.

Wages Per Hour:

1st	2nd	3rd	4th
\$ 31.96	\$ 39.06	\$ 46.16	\$ 53.26

Supplemental Benefits:

\$ 16.56      \$ 20.23      \$ 23.91      \$ 27.06

4-12

**Insulator - Heat & Frost**

**09/01/2024**

**JOB DESCRIPTION** Insulator - Heat & Frost

**DISTRICT 8**

**ENTIRE COUNTIES**

Dutchess, Orange, Putnam, Rockland, Westchester

**WAGES**

Per hour: 07/01/2024

Insulator \$ 60.85

Discomfort &  
Additional Training\*\* 63.92

Fire Stop Work\* 32.97

\* Applies on all exclusive Fire Stop Work (When contract is for Fire Stop work only). No apprentices on these contracts only.

\*\*Applies to work requiring: garb or equipment worn against the body not customarily worn by insulators; psychological evaluation ;special training, including but not limited to "Yellow Badge" radiation training

Note: Additional \$0.50 per hour for work 30 feet or more above floor or ground level.

**SUPPLEMENTAL BENEFITS**

Per hour:

Journeyworker \$ 38.25

Discomfort &  
Additional Training 40.32

Fire Stop Work:  
Journeyworker 19.48

**OVERTIME PAY**

See (B, E, E2, Q, \*T) on OVERTIME PAGE

**HOLIDAY**

Paid: See (1) on HOLIDAY PAGE

Note: Last working day preceding Christmas and New Years day, workers shall work no later than 12:00 noon and shall receive 8 hrs pay.

Overtime: See ( 2\*, 4, 6, 16, 25 ) on HOLIDAY PAGE.

\*Note: Labor Day triple time if worked.

**REGISTERED APPRENTICES**

(1) year terms:

Insulator Apprentices:

1st	2nd	3rd	4th
\$ 32.97	\$ 38.54	\$ 44.12	\$ 49.70

Discomfort & Additional Training Apprentices:

1st	2nd	3rd	4th
\$ 34.51	\$ 40.38	\$ 46.27	\$ 52.16

Supplemental Benefits paid per hour:

Insulator Apprentices:

1st term	\$ 19.48
2nd term	23.23
3rd term	26.98
4th term	30.74

Discomfort & Additional Training Apprentices:

1st term	\$ 20.50
2nd term	24.47

3rd term	28.43	
4th term	32.39	
		8-91

<b>Ironworker</b>	<b>09/01/2024</b>
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**JOB DESCRIPTION** Ironworker

**DISTRICT 9**

**ENTIRE COUNTIES**

Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk, Westchester

**WAGES**

Per Hour:	07/01/2024	01/01/2025 Additional
Stone Derrickmen Rigger	\$ 75.40	\$ 1.64*
Stone Handset Derrickman	72.55	1.11*

\*To be allocated at a later date.

**SUPPLEMENTAL BENEFITS**

Per hour:

Stone Derrickmen Rigger	\$ 45.52
Stone Handset Derrickman	44.76

**OVERTIME PAY**

See (B, D1, \*E, Q, \*\*V) on OVERTIME PAGE

\*Time and one-half shall be paid for all work on Saturday up to eight (8) hours and double time shall be paid for all work thereafter.

\*\* Benefits same premium as wages on Holidays only

**HOLIDAY**

Paid: See (18) on HOLIDAY PAGE  
Overtime: See (5, 6, 8, 25) on HOLIDAY PAGE  
Work stops at schedule lunch break with full day's pay.

**REGISTERED APPRENTICES**

Wage per hour:

Stone Derrickmen Rigger:	1st	2nd	3rd	4th
07/01/2024	\$ 37.20	\$ 53.28	\$ 59.32	\$ 65.36

Supplemental Benefits:

Per hour:				
07/01/2024	23.27	34.39	34.39	34.39

Stone Handset:

1/2 year terms at the following hourly wage rate:

	1st	2nd	3rd	4th
07/01/2024	\$ 35.78	\$ 51.04	\$ 56.79	\$ 62.55

Supplemental Benefits:

Per hour:				
07/01/2024	22.95	34.08	34.08	34.08

9-197D/R

<b>Ironworker</b>	<b>09/01/2024</b>
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**JOB DESCRIPTION** Ironworker

**DISTRICT 4**

**ENTIRE COUNTIES**

Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk, Westchester

**WAGES**

Per Hour:	07/01/2024	01/01/2025
Ornamental	\$ 47.65	Additional
Chain Link Fence	47.65	\$ 1.25/hr*

Guide Rail 47.65

(\*)To be allocated at a later date.

#### SUPPLEMENTAL BENEFITS

Per hour:

Journeyworker: \$ 66.29

#### OVERTIME PAY

See (B, B1, Q, V) on OVERTIME PAGE

#### HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6, 25) on HOLIDAY PAGE

#### REGISTERED APPRENTICES

1 year terms

07/01/2024

1st Term \$ 25.98

2nd Term 28.45

3rd Term 30.80

4th Term 34.39

Supplemental Benefits per hour:

1st Term \$ 16.29

2nd Term 18.29

3rd Term 19.29

4th Term 20.29

4-580-Or

#### Ironworker

09/01/2024

**JOB DESCRIPTION** Ironworker

**DISTRICT** 4

#### ENTIRE COUNTIES

Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk, Westchester

#### WAGES

PER HOUR:

07/01/2024

01/01/2025

Ironworker:

Structural \$ 57.20

Bridges

Machinery

Additional

\$ 1.75/Hr.\*

(\*)To be allocated at a later date.

#### SUPPLEMENTAL BENEFITS

PER HOUR PAID:

Journeyman \$ 89.85

#### OVERTIME PAY

See (B, B1, Q, \*V) on OVERTIME PAGE

\*NOTE: Benefits are calculated for every hour paid.

#### HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6, 18, 19) on HOLIDAY PAGE

#### REGISTERED APPRENTICES

WAGES PER HOUR:

6 month terms at the following rate:

1st \$ 30.23

2nd 30.83

3rd - 6th 31.44

Supplemental Benefits

PER HOUR PAID: 62.47

4-40/361-Str

#### Ironworker

09/01/2024

**JOB DESCRIPTION** Ironworker

**DISTRICT** 4

**ENTIRE COUNTIES**

Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk, Westchester

**PARTIAL COUNTIES**

Rockland: Southern section - south of Convent Road and east of Blue Hills Road.

**WAGES**

Per hour: 07/01/2024

Reinforcing &  
Metal Lathing \$ 56.95

"Base" Wage 55.20  
plus \$ 1.75

"Base" Wage is used to calculate overtime hours only.

**SUPPLEMENTAL BENEFITS**

Per hour:  
Reinforcing & Metal Lathing \$ 44.63

**OVERTIME PAY**

See (B, E, Q, \*X) on OVERTIME PAGE

\*Only \$23.50 per Hour for non worked hours

Supplemental Benefit Premiums for Overtime Hours worked:

Time & One Half \$ 51.13  
Double Time 57.63

**HOLIDAY**

Paid: See (1) on HOLIDAY PAGE  
Overtime: See (5, 6, 11, 13, \*18, \*\*19, 25) on HOLIDAY PAGE

**REGISTERED APPRENTICES**

(1) year terms at the following wage rates:

Prior to 01/01/2020:

1st term	2nd term	3rd term	4th Term
Wage Per Hour:			
\$ 22.55	\$ 28.38	\$ 34.68	\$ 37.18
"Base" Wage			
\$21.00	\$26.80	\$33.10	\$35.60
plus \$1.55	plus \$1.58	plus \$1.58	plus \$1.58

"Base" Wage is used to calculate overtime hours ONLY.

**SUPPLEMENTAL BENIFITS**

Per Hour:

1st term	2nd term	3rd term	4th Term
\$18.17	\$21.34	\$22.00	\$22.50

After 01/01/2020:

1st term	2nd term	3rd term	4th Term
Wage Per Hour:			
\$ 22.55	\$ 23.60	\$ 24.60	\$ 25.65
"Base" Wage			
\$21.00	\$22.00	\$23.00	\$24.00
plus \$1.55	plus \$1.60	plus \$1.60	plus \$1.65

"Base" Wage is used to calculate overtime hours ONLY.

**SUPPLEMENTAL BENIFITS**

Per Hour:

1st term	2nd term	3rd term	4th Term
\$18.40	\$17.40	\$16.45	\$15.45

**Laborer - Building**

**09/01/2024**

**JOB DESCRIPTION** Laborer - Building

**DISTRICT** 8

**ENTIRE COUNTIES**

Putnam, Westchester

**WAGES**

Per hour 07/01/2024

Laborer \$ 43.40  
plus \$5.45\*\*

Laborer/Asbestos & Hazardous  
Materials Removal \$ 45.05\*  
plus \$5.45\*\*

\* Abatement/Removal of:

- Lead based or lead containing paint on materials to be repainted is classified as Painter.
- Asbestos containing roofs and roofing material is classified as Roofer.

\*\* This portion is not subject to overtime premium.

NOTE: Upgrade/Material condition work plan for work performed during non-outage under a wage formula of 90% wage/100% fringe benefits at nuclear power plants.

**SUPPLEMENTAL BENEFITS**

Per hour: 07/01/2024

Journeyworker \$ 31.95

**OVERTIME PAY**

See (B, E, E2, Q, \*V) on OVERTIME PAGE

\*Note: For Sundays and Holidays worked benefits are at the same premium as wages.

**HOLIDAY**

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6, 16, 25) on HOLIDAY PAGE

**REGISTERED APPRENTICES**

LABORER ONLY

Hourly terms at the following wage:

Level A	Level B	Level C	Level D
0-1000	1001-2000	2001-3000	3001-4000
\$ 28.08	\$ 31.90	\$ 35.72	\$ 39.54

Supplemental Benefits per hour:

Apprentices  
All terms \$ 23.60

8-235/B

**Laborer - Heavy&Highway**

**09/01/2024**

**JOB DESCRIPTION** Laborer - Heavy&Highway

**DISTRICT** 8

**ENTIRE COUNTIES**

Putnam, Westchester

**WAGES**

\*\*PUTNAM: APPLIES TO ALL HEAVY & HIGHWAY WORK EXCLUDING HIGHWAYS, STREETS, AND BRIDGES\*\*

GROUP I: Blaster, Quarry Master, Curbs/Asphalt Screedman, Pipe Jacking and Boring Operations Operator, Qualified Dead Condition Pipe Fuser (B Mechanic)

GROUP II: Burner, Drillers(jumbo, joy, wagon, air track, hydraulic), Drill Operator, Self Contained Rotary Drill, Curbs, Raker, Bar Person, Concrete Finisher.

GROUP III: Pavement Breakers, Jeep Operator, Jack Hammer, Pneumatic Tools (all), Gas Driller, Guniting, Railroad Spike Puller, Pipelayer, Chain Saw, Deck winches on scows, Power Buggy Operator, Power Wheelbarrow Operator, Bar Person Helper, Compressed Airline, Water Jet Lance.

GROUP IV: Concrete Laborers, Asph. Worker, Rock Scaler, Vibrator Oper., Bit Grinder, Air Tamper, Pumps, Epoxy (adhesives, fillers and troweled on), Barco Rammer, Concrete Grinder, Crack Router Operator, Guide Rail-digging holes and placing concrete and demolition when not to be replaced, distribution of materials and tightening of bolts.

GROUP V: Drillers Helpers, Common Laborer, Mason Tenders, Signal Person, Pit Person, Truck Spotter, Powder Person, Landscape/Nursery Person, Dump Person, Temp. Heat.

GROUP VIA: Asbestos/Toxic Waste Laborer-All removal (Roads, Tunnels, Landfills, etc.) Confined space laborer, Bio-remediation, Phyto-remediation, Lead or Hazardous material, Abatement Laborer.

Wages:(per hour) 07/01/2024

GROUP I	\$ 50.62*
GROUP II	49.27*
GROUP III	48.87*
GROUP IV	48.52*
GROUP V	48.17*
GROUP VIA	50.17*
Operator Qualified	
Gas Mechanic(A Mech)	60.62*
Flagperson	41.82*

\*NOTE: To calculate overtime premiums, deduct \$0.10 from above wages

#### SHIFT WORK

A shift premium will be paid on Public Work contracts for off-shift or irregular shift work when mandated by the NYS D.O.T. or other Governmental Agency contracts. Employees shall receive an additional 15% per hour above current rate for all regular and irregular shift work. Premium pay shall be calculated using the 15% per hour differential as base rate.

#### SUPPLEMENTAL BENEFITS

Per hour:

Journeyworker:

First 40 Hours	
Per Hour	\$ 27.78
Over 40 Hours	
Per Hour	21.03

#### OVERTIME PAY

See (B, E, P, R, S) on OVERTIME PAGE

#### HOLIDAY

Paid: See (5, 6, 8, 15, 25, 26) on HOLIDAY PAGE

Overtime: See (5, 6, 8, 15, 25, 26) on HOLIDAY PAGE

NOTE: For Holiday Overtime: 5, 6 - Code 'S' applies

For Holiday Overtime: 8, 15, 25, 26 - Code 'R' applies

#### REGISTERED APPRENTICES

	1st term 1-1000hrs	2nd term 1001-2000hrs	3rd term 2001-3000hrs	4th term 3001-4000hrs
07/01/2024	\$ 28.07	\$ 33.12	\$ 37.94	\$ 42.76

Supplemental Benefits per hour:

1st term	\$ 3.85 - After 40 hours: \$ 3.50
2nd term	\$ 3.95 - After 40 hours: 3.50
3rd term	\$ 4.45 - After 40 hours: 3.90
4th term	\$ 5.00 - After 40 hours: 4.40

8-60H/H

#### Laborer - Tunnel

09/01/2024

**JOB DESCRIPTION** Laborer - Tunnel

**DISTRICT** 11

#### ENTIRE COUNTIES

Columbia, Dutchess, Greene, Orange, Otsego, Putnam, Rockland, Sullivan, Ulster, Westchester

#### PARTIAL COUNTIES

Chenango: Townships of Columbus, Sherburne and New Berlin.

Delaware: Townships of Andes, Bovina, Middletown, Roxbury, Franklin, Hamden, Stamford, Delhi, Kortright, Harpersfield, Merideth and Davenport.

## WAGES

Class 1: All support laborers/sandhogs working above the shaft or tunnel.

Class 2: All laborers/sandhogs working in the shaft or tunnel.

Class 4: Safety Miners

Class 5: Site work related to Shaft/Tunnel

WAGES: (per hour)

	07/01/2024	06/01/2025
Class 1	\$ 57.05	\$ 58.55
Class 2	59.20	60.70
Class 4	65.60	67.10
Class 5	49.90	51.40

Toxic and hazardous waste, lead abatement and asbestos abatement work will be paid an additional \$ 3.00 an hour.

## SHIFT WORK

SHIFT DIFFERENTIAL...On all Government mandated irregular shift work:

- Employee shall be paid at time and one half the regular rate Monday through Friday.
- Saturday shall be paid at 1.65 times the regular rate.
- Sunday shall be paid at 2.15 times the regular rate.

## SUPPLEMENTAL BENEFITS

Per hour:

Benefit 1	\$ 36.98	\$ 38.23
Benefit 2	55.39	59.99
Benefit 3	74.58	76.73

Benefit 1 applies to straight time hours, paid holidays not worked.

Benefit 2 applies to over 8 hours in a day (M-F), irregular shift work hours worked, and Saturday hours worked.

Benefit 3 applies to Sunday and Holiday hours worked.

## OVERTIME PAY

See (B, E, Q, X) on OVERTIME PAGE

## HOLIDAY

Paid: See (5, 6, 15, 25) on HOLIDAY PAGE

Overtime: See (5, 6, 15, 16, 25) on HOLIDAY PAGE

When a recognized Holidays falls on Saturday or Sunday, holidays falling on Saturday shall be recognized or observed on Friday and holidays falling on Sunday shall be recognized or observed on Monday. Employees ordered to work on the Saturday or Sunday of the holiday or on the recognized or the observed Friday or Monday for those holidays falling on Saturday or Sunday shall receive double time the established rate and benefits for the holiday.

## REGISTERED APPRENTICES

FOR APPRENTICE RATES, refer to the appropriate Laborer Heavy & Highway wage rate contained in the wage schedule for the County and location where the work is to be performed.

11-17/60/235/754Tun

## Lineman Electrician

09/01/2024

**JOB DESCRIPTION** Lineman Electrician

**DISTRICT** 6

**ENTIRE COUNTIES**

Westchester

## WAGES

A Lineman/Technician shall perform all overhead aerial work. A Lineman/Technician on the ground will install all electrical panels, connect all grounds, install and connect all electrical conductors, assembly of all electrical materials, conduit, pipe or raceway; placing of fish wire; pulling of cables, wires or fiber optic cable through such raceways; splicing of conductors; dismantling of such structures, lines or equipment.

Crane Operators: Operation of any type of crane on line projects.

Crawler Backhoe: Operation of tracked excavator/crawler backhoe with 1/2 yard bucket or larger on line projects.

Digging Machine Operator: All other digging equipment and augering on line projects.



A Groundman/Truck Driver shall: Build and set concrete forms, handle steel mesh, set footer cages, transport concrete in a wheelbarrow, hand or machine concrete vibrator, finish concrete footers, mix mortar, grout pole bases, cover and maintain footers while curing in cold weather, operate jack hammer, operate hand pavement breaker, tamper, concrete and other motorized saws, as a drill helper, operate and maintain generators, water pumps, chainsaws, sand blasting, operate mulching and seeding machine, air tools, electric tools, gas tools, load and unload materials, hand shovel and/or broom, prepare and pour mastic and other fillers, assist digger operator equipment/operator in ground excavation and restoration, landscape work and painting. Only when assisting a lineman technician, a groundman/truck driver may assist in installing conduit, pipe, cables and equipment.

NOTE: Includes Teledata Work within ten (10) feet of High Voltage Transmission Lines. Also includes digging of holes for poles, anchors, footer, and foundations for electrical equipment.

Below rates apply to electrical overhead and underground distribution and maintenance work and overhead and underground transmission line work, electrical substations, switching structures, continuous pipe-type underground fluid or gas filled transmission conduit and cable installations, maintenance jobs or projects, railroad catenary installations and maintenance, third rail installations, the bonding of rails and the installation of fiber optic cable. Includes access matting for line work.

Per hour: 07/01/2024

Group A:

Lineman, Tech, Welder	\$ 61.91
Crane, Crawler Backhoe	61.91
Cable Splicer-Pipe Type	68.10
Cert. Welder-Pipe Type	65.01

Group B:

Digging Mach Operator	55.72
Tractor Trailer Driver	52.62
Groundman, Truck Driver	49.53
Equipment Mechanic	49.53
Flagman	37.15

Additional \$1.00 per hour for entire crew when a helicopter is used.

**SHIFT WORK**

THE FOLLOWING RATES WILL APPLY ON ALL CONTRACTING AGENCY MANDATED MULTIPLE SHIFTS OF AT LEAST FIVE (5) DAYS DURATION WORKED BETWEEN THE HOURS LISTED BELOW:

1ST SHIFT	8:00 AM TO 4:30 PM REGULAR RATE
2ND SHIFT	4:30 PM TO 1:00 AM REGULAR RATE PLUS 17.3%
3RD SHIFT	12:30 AM TO 9:00 AM REGULAR RATE PLUS 31.4%

**SUPPLEMENTAL BENEFITS**

Per hour worked (but also required on non-worked holidays):

07/01/2024

Group A	\$ 30.90
	*plus 7% of the hourly wage paid

Group B	\$ 26.90
	*plus 7% of the hourly wage paid

\*The 7% is based on the hourly wage paid, straight time or premium time.

**OVERTIME PAY**

See ( B, E, Q, X) on OVERTIME PAGE. NOTE: Double time for emergency work designated by the Dept. of Jurisdiction.

WAGE CAP - Double the straight time hourly base wage shall be the maximum hourly wage compensation for any hour worked. Contractor is still responsible to pay the hourly benefit amount for each hour worked.

**HOLIDAY**

Paid	See ( 5, 6, 8, 13, 25 ) on HOLIDAY PAGE plus Governor of NYS Election Day.
Overtime	See ( 5, 6, 8, 13, 25 ) on HOLIDAY PAGE plus Governor of NYS Election Day.

NOTE: All paid holidays falling on Saturday shall be observed on the preceding Friday. All paid holidays falling on Sunday shall be observed on the following Monday. Supplements for holidays paid at straight time.

## REGISTERED APPRENTICES

WAGES per hour: 1000 hour terms at the following percentage of the applicable Journeyworker's Lineman wage.

1st	2nd	3rd	4th	5th	6th	7th
60%	65%	70%	75%	80%	85%	90%

SUPPLEMENTAL BENEFITS per hour:

07/01/2024

\$ 26.90

\*plus 7% of  
the hourly  
wage paid

\*The 7% is based on the hourly wage paid, straight time or premium time.

6-1249aWest

### Lineman Electrician - Teledata

09/01/2024

**JOB DESCRIPTION** Lineman Electrician - Teledata

**DISTRICT** 6

#### ENTIRE COUNTIES

Albany, Allegany, Broome, Cattaraugus, Cayuga, Chautauqua, Chemung, Chenango, Clinton, Columbia, Cortland, Delaware, Dutchess, Erie, Essex, Franklin, Fulton, Genesee, Greene, Hamilton, Herkimer, Jefferson, Lewis, Livingston, Madison, Monroe, Montgomery, Niagara, Oneida, Onondaga, Ontario, Orange, Orleans, Oswego, Otsego, Putnam, Rensselaer, Rockland, Saratoga, Schenectady, Schoharie, Schuyler, Seneca, St. Lawrence, Steuben, Sullivan, Tioga, Tompkins, Ulster, Warren, Washington, Wayne, Westchester, Wyoming, Yates

#### WAGES

Per hour:

For outside work, stopping at first point of attachment (demarcation).

07/01/2024

01/01/2025

Cable Splicer	\$ 39.24	\$ 40.81
Installer, Repairman	\$ 37.24	\$ 38.73
Teledata Lineman	\$ 37.24	\$ 38.73
Tech., Equip. Operator	\$ 37.24	\$ 38.73
Groundman	\$ 19.74	\$ 20.53

NOTE: EXCLUDES Teledata work within ten (10) feet of High Voltage (600 volts and over) transmission lines. For this work please see LINEMAN.

#### SHIFT WORK

THE FOLLOWING RATES APPLY WHEN THE CONTRACTING AGENCY MANDATES MULTIPLE SHIFTS OF AT LEAST FIVE (5) DAYS DURATION ARE WORKED. WHEN TWO (2) OR THREE (3) SHIFTS ARE WORKED THE FOLLOWING RATES APPLY:

1ST SHIFT	REGULAR RATE
2ND SHIFT	REGULAR RATE PLUS 10%
3RD SHIFT	REGULAR RATE PLUS 15%

#### SUPPLEMENTAL BENEFITS

Per hour:

07/01/2024

01/01/2025

Journeyworker	\$ 5.70	\$ 5.70
	*plus 3% of the hour wage paid	*plus 3% of the hour wage paid

\*The 3% is based on the hourly wage paid, straight time rate or premium rate.

#### OVERTIME PAY

See (B, E, Q) on OVERTIME PAGE

WAGE CAP - Double the straight time hourly base wage shall be the maximum hourly wage compensation for any hour worked. Contractor is still responsible to pay the hourly benefit amount for each hour worked.

#### HOLIDAY

Paid: See (1) on HOLIDAY PAGE  
Overtime: See (5, 6, 16) on HOLIDAY PAGE

6-1249LT - Teledata

### Lineman Electrician - Traffic Signal, Lighting

09/01/2024

**JOB DESCRIPTION** Lineman Electrician - Traffic Signal, Lighting

**DISTRICT** 6

**ENTIRE COUNTIES**

Westchester

**WAGES**

Lineman/Technician shall perform all overhead aerial work. A Lineman/Technician on the ground will install all electrical panels, connect all grounds, install and connect all electrical conductors which includes, but is not limited to road loop wires; conduit and plastic or other type pipes that carry conductors, flex cables and connectors, and to oversee the encasement or burial of such conduits or pipes.

Crane Operators: Operation of any type of crane on Traffic Signal/Lighting projects.

Crawler Backhoe: Operation of tracked excavator/crawler backhoe with 1/2 yard bucket or larger on Traffic Signal/Lighting projects.

Digging Machine Operator: All other digging equipment and augering on Traffic Signal/Lighting projects.

A Groundman/Groundman Truck Driver shall: Build and set concrete forms, handle steel mesh, set footer cages, transport concrete in a wheelbarrow, hand or machine concrete vibrator, finish concrete footers, mix mortar, grout pole bases, cover and maintain footers while curing in cold weather, operate jack hammer, operate hand pavement breaker, tamper, concrete and other motorized saws, as a drill helper, operate and maintain generators, water pumps, chainsaws, sand blasting, operate mulching and seeding machine, air tools, electric tools, gas tools, load and unload materials, hand shovel and/or broom, prepare and pour mastic and other fillers, assist digger operator/equipment operator in ground excavation and restoration, landscape work and painting. Only when assisting a lineman technician, a groundman/truck driver may assist in installing conduit, pipe, cables and equipment.

A flagger's duties shall consist of traffic control only.

Per hour: 07/01/2024

**Group A:**

Lineman, Technician	\$ 55.95
Crane, Crawler Backhoe	55.95
Certified Welder	58.75

**Group B:**

Digging Machine	50.36
Tractor Trailer Driver	47.56
Groundman, Truck Driver	44.76
Equipment Mechanic	44.76
Flagman	33.57

Above rates are applicable for installation, testing, operation, maintenance and repair on all Traffic Control (Signal) and Illumination (Lighting) projects, Traffic Monitoring Systems, and Road Weather Information Systems. Includes digging of holes for poles, anchors, footer foundations for electrical equipment; assembly of all electrical materials or raceway; placing of fish wire; pulling of cables, wires or fiber optic cable through such raceways; splicing of conductors; dismantling of such structures, lines or equipment.

**SHIFT WORK**

THE FOLLOWING RATES WILL APPLY ON ALL CONTRACTING AGENCY MANDATED MULTIPLE SHIFTS OF AT LEAST FIVE (5) DAYS DURATION WORKED BETWEEN THE HOURS LISTED BELOW:

1ST SHIFT	8:00 AM TO 4:30 PM REGULAR RATE
2ND SHIFT	4:30 PM TO 1:00 AM REGULAR RATE PLUS 17.3%
3RD SHIFT	12:30 AM TO 9:00 AM REGULAR RATE PLUS 31.4%

**SUPPLEMENTAL BENEFITS**

Per hour worked:

07/01/2024

**Group A**

\$ 30.90  
\*plus 7% of  
the hourly  
wage paid

**Group B**

\$ 26.90  
\*plus 7% of  
the hourly  
wage paid

\*The 7% is based on the hourly wage paid, straight time or premium time.

**OVERTIME PAY**

See (B, E, Q, X) on OVERTIME PAGE. \*Note\* Double time for emergency work designated by the Dept. of Jurisdiction.

WAGE CAP - Double the straight time hourly base wage shall be the maximum hourly wage compensation for any hour worked. Contractor is still responsible to pay the hourly benefit amount for each hour worked.

HOLIDAY

Paid: See ( 5, 6, 8, 13, 25 ) on HOLIDAY PAGE and Governor of NYS Election Day.  
Overtime: See ( 5, 6, 8, 13, 25 ) on HOLIDAY PAGE and Governor of NYS Election Day.

NOTE: All paid holidays falling on Saturday shall be observed on the preceding Friday. All paid holidays falling on Sunday shall be observed on the following Monday. Supplements for holidays paid at straight time.

REGISTERED APPRENTICES

WAGES per hour: 1000 hour terms at the following percentage of the applicable Journeyworker's Lineman wage.

1st	2nd	3rd	4th	5th	6th	7th
60%	65%	70%	75%	80%	85%	90%

SUPPLEMENTAL BENEFITS per hour:

07/01/2024

\$ 26.90  
\*plus 7% of  
the hourly  
wage paid

\*The 7% is based on the hourly wage paid, straight time or premium time.

6-1249aWestLT

Mason - Building	09/01/2024
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JOB DESCRIPTION Mason - Building

DISTRICT 9

ENTIRE COUNTIES

Nassau, Rockland, Suffolk, Westchester

WAGES

Per hour:	07/01/2024	12/02/2024
Tile Setters	\$ 63.91	Additional \$ 0.71*

\*To be allocated at a later date.

SUPPLEMENTAL BENEFITS

Per Hour:	\$ 27.66* + \$8.50
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\* This portion of benefits subject to same premium rate as shown for overtime wages.

OVERTIME PAY

See (B, E, Q, V) on OVERTIME PAGE  
Work beyond 10 hours on Saturday shall be paid at double the hourly wage rate.

HOLIDAY

Paid: See (1) on HOLIDAY PAGE  
Overtime: See (5, 6, 11, 15, 16, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES

Wage per hour:

(750 hour) term at the following wage rate:

Term:										
1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	
1-750	751-1500	1501-2250	2251-3000	3001-3750	3751-4500	4501-5250	5251-6000	6001-6750	6501-7000	
07/01/2024	\$22.19	\$27.21	\$34.45	\$39.46	\$43.07	\$46.58	\$50.23	\$55.24	\$57.71	\$62.00

Supplemental Benefits per hour:

1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
07/01/2024									

\$12.55*	\$12.55*	\$15.36*	\$15.36*	\$16.36*	\$17.86*	\$18.86*	\$18.86*	\$18.86*	\$24.11*
+\$ .76	+\$ .81	+\$ .91	+\$ .96	+\$ 1.43	+\$ 1.48	+\$ 1.91	+\$ 1.97	+\$ 4.57	+\$ 5.18

\* This portion of benefits subject to same premium rate as shown for overtime wages.

9-7/52A

<b>Mason - Building</b>	<b>09/01/2024</b>
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**JOB DESCRIPTION** Mason - Building

**DISTRICT** 11

**ENTIRE COUNTIES**

Putnam, Rockland, Westchester

**PARTIAL COUNTIES**

Orange: Only the Township of Tuxedo.

**WAGES**

Per hour:

07/01/2024

Bricklayer	\$ 47.44
Cement Mason	47.44
Plasterer/Stone Mason	47.44
Pointer/Caulker	47.44

Additional \$1.00 per hour for power saw work

Additional \$0.50 per hour for swing scaffold or staging work

**SHIFT WORK**

SHIFT WORK: When shift work or an irregular workday is mandated or required by state, federal, county, local or other governmental agency contracts, the following premiums apply:

Irregular workday requires 15% premium

Second shift an additional 15% of wage plus benefits to be paid

Third shift an additional 25% of wage plus benefits to be paid

**SUPPLEMENTAL BENEFITS**

Per hour:

Journeyman	\$ 38.50
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**OVERTIME PAY**

OVERTIME:

Cement Mason See ( B, E, Q, W ) on OVERTIME PAGE.

All Others See ( B, E, Q ) on OVERTIME PAGE.

**HOLIDAY**

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6, 16, 25) on HOLIDAY PAGE

Whenever any of the above holidays fall on Sunday, they will be observed on Monday. Whenever any of the above holidays fall on Saturday, they will be observed on Friday.

**REGISTERED APPRENTICES**

Wages per hour:

750 hour terms at the following percentage of Journeyman's wage

1st	2nd	3rd	4th	5th	6th	7th	8th
50%	55%	60%	65%	70%	75%	80%	85%

Supplemental Benefits per hour

750 hour terms at the following percentage of journeyman supplements

1st	2nd	3rd	4th	5th	6th	7th	8th
50%	55%	60%	65%	70%	75%	80%	85%

Apprentices indentured before June 1st, 2011 receive full journeyman benefits

11-5wp-b

<b>Mason - Building</b>	<b>09/01/2024</b>
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**JOB DESCRIPTION** Mason - Building

**DISTRICT** 9

**ENTIRE COUNTIES**

Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk, Westchester

## WAGES

Building

	07/01/2024	01/01/2025
Wages per hour:		Additional
Mosaic & Terrazzo Mechanic	\$ 60.98	\$ 1.06*
Mosaic & Terrazzo Finisher	58.96	

\*To be allocated at a later date.

## SUPPLEMENTAL BENEFITS

Per hour:

Mosaic & Terrazzo Mechanic	\$ 31.36* + \$9.78
Mosaic & Terrazzo Finisher	\$ 31.36* + \$9.77

\*This portion of benefits subject to same premium rate as shown for overtime wages.

## OVERTIME PAY

See (A, E, Q) on OVERTIME PAGE

07/01/2024- Deduct \$7.00 from hourly wages before calculating overtime.

## HOLIDAY

Paid: See (1) on HOLIDAY PAGE  
Overtime: See (5, 6, 8, 11, 15, 16, 25) on HOLIDAY PAGE  
Easter Sunday is an observed holiday. Holidays falling on a Saturday will be observed on that Saturday. Holidays falling on a Sunday will be celebrated on the Monday.

## REGISTERED APPRENTICES

Wages Per hour:

	1st 0- 1500	2nd 1501- 3000	3rd 3001- 3750	4th 3751- 4500	5th 4501- 5250	6th 5251- 6000
07/01/2024	\$ 25.19	\$ 32.39	\$ 38.18	\$ 40.78	\$ 49.00	\$ 55.75

Supplemental Benefits per hour:

07/01/2024	\$7.12* + 3.43	\$9.16* + 4.40	\$17.22* + 5.87	\$23.86* + 6.84	\$24.86* + 7.83	\$27.36* + 8.80
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\*This portion of benefits subject to same premium rate as shown for overtime wages.

9-7/3

## Mason - Building

09/01/2024

**JOB DESCRIPTION** Mason - Building

**DISTRICT** 9

## ENTIRE COUNTIES

Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk, Westchester

## WAGES

Per hour:	07/01/2024	01/06/2025
		Additional

Building-Marble Restoration:

Marble, Stone &	\$ 47.72	\$ 0.57*
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Terrazzo Polisher

\*To be allocated at a later date.

## SUPPLEMENTAL BENEFITS

Per Hour:

Journeyworker:

Building-Marble Restoration:

Marble, Stone &

Polisher \$ 31.50

**OVERTIME PAY**

See (B, \*E, Q, V) on OVERTIME PAGE

\* On Saturdays, 8th hour and successive hours paid at double hourly rate.

**HOLIDAY**

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6, 8, 11, 15, 25) on HOLIDAY PAGE

**REGISTERED APPRENTICES**

WAGES per hour:

900 hour term at the following wage:

1st 1- 900	2nd 901- 1800	3rd 1801- 2700	4th 2701
\$ 33.40	\$ 38.18	\$ 42.94	\$ 47.72

Supplemental Benefits Per Hour:

29.06	29.87	30.69	31.50
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9-7/24-MP

**Mason - Building**

**09/01/2024**

**JOB DESCRIPTION** Mason - Building

**DISTRICT 9**

**ENTIRE COUNTIES**

Bronx, Dutchess, Kings, Nassau, New York, Orange, Putnam, Queens, Richmond, Rockland, Suffolk, Sullivan, Ulster, Westchester

**WAGES**

Per Hour:

07/01/2024	01/06/2025 Additional \$ 0.75*
\$ 63.92	

Marble Cutters & Setters

\*To be allocated at a later date.

**SUPPLEMENTAL BENEFITS**

Per Hour:

Journeyworker \$ 40.05

**OVERTIME PAY**

See (B, E, Q, V) on OVERTIME PAGE

**HOLIDAY**

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6, 8, 11, 15, 16, 25) on HOLIDAY PAGE

**REGISTERED APPRENTICES**

Wage Per Hour:

07/01/2024

750 hour terms at the following wage

1st	2nd	3rd	4th	5th	6th	7th	8th
0- 3000	3001- 3750	3751- 4500	4501- 5250	5251- 6000	6001- 6750	6751- 7500	7500+
\$ 27.01	\$ 40.52	\$ 43.88	\$ 47.26	\$ 50.64	\$ 54.32	\$ 60.71	\$ 63.92

Supplemental Benefits per hour:

07/01/2024

1st	2nd	3rd	4th	5th	6th	7th	8th
\$ 26.42	\$ 29.76	\$ 30.61	\$ 31.44	\$ 32.28	\$ 37.55	\$ 39.23	\$ 40.05

<b>Mason - Building</b>	<b>09/01/2024</b>
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**JOB DESCRIPTION** Mason - Building

**DISTRICT** 9

**ENTIRE COUNTIES**

Nassau, Rockland, Suffolk, Westchester

**WAGES**

Per hour:	07/01/2024	12/02/2024
		Additional
Tile Finisher	\$ 49.08	\$ 0.59*

\*To be allocated at a later date.

**SUPPLEMENTAL BENEFITS**

Per Hour:	\$ 24.56*
	+ 8.32

\*This portion of benefits is subjected to same premium rate as shown for overtime wages

**OVERTIME PAY**

See (B, E, Q, \*V) on OVERTIME PAGE

\*Work beyond 10 hours on a Saturday shall be paid at double the hourly wage rate.

**HOLIDAY**

Paid:	See (1) on HOLIDAY PAGE
Overtime:	See (5, 6, 11, 15, 16, 25) on HOLIDAY PAGE

9-7/88A-tf

<b>Mason - Building</b>	<b>09/01/2024</b>
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**JOB DESCRIPTION** Mason - Building

**DISTRICT** 9

**ENTIRE COUNTIES**

Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk, Westchester

**WAGES**

Per hour:	07/01/2024	01/06/2025
Marble, Stone,		Additional
Maintenance Finishers:	\$ 27.72	\$ 0.41*

Note 1: An additional \$2.00 per hour  
for time spent grinding floor using  
"60 grit" and below.

Note 2: Flaming equipment operator  
shall be paid an additional \$25.00 per day.

\*To be allocated at a later date.

**SUPPLEMENTAL BENEFITS**

Per Hour:

Marble, Stone	
Maintenance Finishers:	\$ 15.74

**OVERTIME PAY**

See (B, \*E, Q, V) on OVERTIME PAGE

\*Double hourly rate after 8 hours on Saturday

**HOLIDAY**

Paid:	See (5, 6, 8, 11, 15, 25) on HOLIDAY PAGE
Overtime:	See (5, 6, 8, 11, 15, 25) on HOLIDAY PAGE
1st term apprentice gets paid for all observed holidays.	

**REGISTERED APPRENTICES**

WAGES per hour:	07/01/2024
0-750	\$ 22.32
751-1500	23.04
1501-2250	23.75
2251-3000	24.48



3001-3750	25.56
3751-4500	27.00
4501+	27.72

Supplemental Benefits:  
Per hour:

0-750	12.69
751-1500	13.10
1501-2250	13.51
2251-3000	13.91
3001-3750	14.52
3751-4500	15.33
4501+	15.74

9-7/24M-MF

**Mason - Building / Heavy&Highway**

**09/01/2024**

**JOB DESCRIPTION** Mason - Building / Heavy&Highway

**DISTRICT** 9

**ENTIRE COUNTIES**

Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk, Westchester

**WAGES**

Per hour: 07/01/2024 01/06/2025  
Additional

Marble-Finisher \$ 49.99 \$ 0.53\*

\*To be allocated at a later date.

**SUPPLEMENTAL BENEFITS**

Journeyworker:  
Per hour

Marble- Finisher \$ 37.39

**OVERTIME PAY**

See (B, E, Q, V) on OVERTIME PAGE

Work beyond 8 hours on a Saturday shall be paid at double the rate.

**HOLIDAY**

Overtime: See (5, 6, 8, 11, 15, 16, 25) on HOLIDAY PAGE

When an observed holiday falls on a Sunday, it will be observed the next day.

9-7/20-MF

**Mason - Heavy&Highway**

**09/01/2024**

**JOB DESCRIPTION** Mason - Heavy&Highway

**DISTRICT** 11

**ENTIRE COUNTIES**

Putnam, Rockland, Westchester

**PARTIAL COUNTIES**

Orange: Only the Township of Tuxedo.

**WAGES**

Per hour: 07/01/2024

Bricklayer	\$ 47.94
Cement Mason	47.94
Marble/Stone Mason	47.94
Plasterer	47.94
Pointer/Caulker	47.94

Additional \$1.00 per hour for power saw work

Additional \$0.50 per hour for swing scaffold or staging work

**SHIFT WORK**

When shift work or an irregular workday is mandated or required by state, federal, county, local or other governmental contracts, the following rates apply:

Irregular workday requires 15% premium

Second shift an additional 15% of wage plus benefits to be paid

Third shift an additional 25% of wage plus benefits to be paid

## SUPPLEMENTAL BENEFITS

Per hour:

Journeyman \$ 38.50

## OVERTIME PAY

Cement Mason See ( B, E, Q, W )

All Others See ( B, E, Q, )

## HOLIDAY

Paid: See (5, 6, 16, 25) on HOLIDAY PAGE

Overtime: See (5, 6, 16, 25) on HOLIDAY PAGE

- Whenever any of the above holidays fall on Sunday, they will be observed on Monday. Whenever any of the above holidays fall on Saturday, they will be observed on Friday.

- Supplemental Benefits are not paid for paid Holiday

- If Holiday is worked, Supplemental Benefits are paid for hours worked.

- Whenever an Employee works within three (3) calendar days before a holiday, the Employee shall be paid for the Holiday.

## REGISTERED APPRENTICES

Wages per hour:

750 hour terms at the following percentage of Journeyman's wage

1st	2nd	3rd	4th	5th	6th	7th	8th
50%	55%	60%	65%	70%	75%	80%	85%

Supplemental Benefits per hour

750 hour terms at the following percentage of journeyman supplements

1st	2nd	3rd	4th	5th	6th	7th	8th
50%	55%	60%	65%	70%	75%	80%	85%

Apprentices indentured before June 1st, 2011 receive full journeyman benefits

11-5WP-H/H

## Operating Engineer - Building

09/01/2024

**JOB DESCRIPTION** Operating Engineer - Building

**DISTRICT** 9

## ENTIRE COUNTIES

Bronx, Kings, New York, Putnam, Queens, Richmond, Westchester

## PARTIAL COUNTIES

Dutchess: that part of Dutchess County lying south of the North City Line of the City of Poughkeepsie.

## WAGES

NOTE: Construction surveying

Party Chief--One who directs a survey party

Instrument Man--One who runs the instrument and assists Party Chief.

Rodman--One who holds the rod and assists the Survey Crew

Wages:(Per Hour) 07/01/2024

Building Construction:

Party Chief	\$ 79.99
Instrument Man	60.36
Rodman	40.45

Steel Erection:

Party Chief	83.13
Instrument Man	64.21
Rodman	44.33

Heavy Construction-NYC counties only:  
(Foundation, Excavation.)

Party Chief	88.06
Instrument man	65.66
Rodman	55.70

#### **SUPPLEMENTAL BENEFITS**

Per Hour:	07/01/2024
Building Construction	\$ 28.63* +\$ 7.65
Steel Erection	29.23* + 7.65
Heavy Construction	30.04* + 7.64

\* This portion subject to SAME premium as wages

Non-Worked Holiday Supplemental Benefit:  
21.83

#### **OVERTIME PAY**

See (A, B, E, Q) on OVERTIME PAGE

Code "A" applies to Building Construction and has double the rate after 7 hours on Saturdays.

Code "B" applies to Heavy Construction and Steel Erection and had double the rate after 8 hours on Saturdays.

#### **HOLIDAY**

Paid: See (5, 6, 9, 11, 15, 16, 25) on HOLIDAY PAGE  
Overtime: See (5, 6, 9, 11, 15, 16, 25) on HOLIDAY PAGE

9-15Db

### **Operating Engineer - Building**

**09/01/2024**

**JOB DESCRIPTION** Operating Engineer - Building

**DISTRICT 8**

#### **ENTIRE COUNTIES**

Putnam, Westchester

#### **PARTIAL COUNTIES**

Dutchess: All the counties of Westchester and Putnam and the southern part of Dutchess County defined by the northern boundary line of the City of Poughkeepsie, then due east to Route 115, then north along Route 115 to Bedell Road, then east along Bedell Road to Van Wagner Road, then north along Van Wagner Road to Bower Road, then east along Bower Road to Route 44 and along Route 44 east to Route 343, then along Route 343 east to the northern boundary of Town of Dover Plains and east along the northern boundary of Town of Dover Plains to the border line of the State of Connecticut and bordered on the west by the middle of the Hudson River.

#### **WAGES**

##### **GROUP I:**

Cranes (All Types up to 49 tons), Boom Trucks, Cherry Pickers (All Types), Clamshell Crane, Derrick (Stone and Steel), Dragline, Franki Pile Rig or similar, High Lift (Lull or similar) with crane attachment and winch used for hoisting or lifting, Hydraulic Cranes, Pile Drivers, Potain and similar.

Cranes (All types 50-99 tons), Drill Rig Casa Grande (CAT or similar), Franki Pile Rig or similar, Hydraulic Cranes (All types including Crawler Cranes- No specific boom length).

Cranes (All types 100 tons and over), All Tower Cranes, All Climbing Cranes irrespective of manufacturer and regardless of how the same is rigged, Franki Pile Rig or similar, Conventional Cranes (All types including Crawler Cranes-No specific boom length), Hydraulic Cranes.

GROUP I-A: Barber Green Loader-Euclid Loader, Bulldozer, Carrier-Trailer Horse, Concrete Cleaning Decontamination Machine Operator, Concrete-Portable Hoist, Conway or Similar Mucking Machines, Elevator & Cage, Excavators all types, Front End Loaders, Gradall, Shovel, Backhoe, etc.(Crawler or Truck), Heavy Equipment Robotics Operator/Mechanic, Hoist Engineer-Material, Hoist Portable Mobile Unit, Hoist(Single, Double or Triple Drum), Horizontal Directional Drill Locator, Horizontal Directional Drill Operator and Jersey Spreader, Letourneau or Tournapull(Scrapers over 20 yards Struck), Lift Slab Console, etc., Lull HiLift or Similar, Master Environmental Maintenance Mechanics, Mucking Machines Operator/Mechanic or Similar Type, Overhead Crane, Pavement Breaker(Air Ram), Paver(Concrete), Post Hole Digger, Power House Plant, Road Boring Machine, Road Mix Machine, Ross Carrier and Similar Machines, Rubber tire double end backhoes and similar machines, Scoopmobile Tractor-Shovel Over 1.5 yards, Shovel (Tunnels), Spreader (Asphalt) Telephie(Cableway), Tractor Type Demolition Equipment, Trenching Machines-Vermeer Concrete Saw Trencher and Similar, Ultra High Pressure Waterjet Cutting Tool System, Vacuum Blasting Machine operator/mechanic, Winch Truck A Frame.

GROUP I-B: Compressor (Steel Erection), Mechanic (Outside All Types), Negative Air Machine (Asbestos Removal), Push Button (Buzz Box) Elevator.

GROUP II: Compactor Self-Propelled, Concrete Pump, Crane Operator in Training (Over 100 Tons), Grader, Machines Pulling Sheep's Foot Roller, Roller (4 ton and over), Scrapers (20 yards Struck and Under), Vibratory Rollers, Welder.

GROUP III-A: Asphalt Plant, Concrete Mixing Plants, Forklift (All power sources), Joy Drill or similar, Tractor Drilling Machine, Loader (1 1/2 yards and under), Portable Asphalt Plant, Portable Batch Plant, Portable Crusher, Skid Steer (Bobcat or similar), Stone Crusher, Well Drilling Machine, Well Point System.

GROUP III-B: Compressor Over 125 cu. Feet, Conveyor Belt Machine regardless of size, Compressor Plant, Ladder Hoist, Stud Machine.

GROUP IV-A: Batch Plant, Concrete Breaker, Concrete Spreader, Curb Cutter Machine, Finishing Machine-Concrete, Fine Grading Machine, Hepa Vac Clean Air Machine, Material Hopper(sand, stone, cement), Mulching Grass Spreader, Pump Gypsum etc, Pump-Plaster-Grout-Fireproofing. Roller(Under 4 Ton),Spreading and Fine Grading Machine, Steel Cutting Machine, Siphon Pump, Tar Joint Machine, Television Cameras for Water, Sewer, Gas etc. Turbo Jet Burner or Similar Equipment, Vibrator (1 to 5).

GROUP IV-B: Compressor (all types), Heater (All Types), Fire Watchman, Lighting Unit (Portable & Generator) Pump, Pump Station(Water, Sewer, Portable, Temporary), Welding Machine (Steel Erection & Excavation).

GROUP V: Mechanics Helper, Motorized Roller (walk behind), Stock Attendant, Welder's Helper, Maintenance Engineer Crane(75 ton and over).

Group VI-A: Welder Certified

GROUP VI-B: Utility Man, Warehouse Man.

WAGES: (per hour)

07/01/2024

**GROUP I**

Cranes- up to 49 tons \$ 67.43

Cranes- 50 tons to 99 tons 69.77

Cranes- 100 tons and over 79.64

GROUP I-A 59.04

GROUP I-B 54.41

GROUP II 56.97

GROUP III-A 54.88

GROUP III-B 52.25

GROUP IV-A 54.33

GROUP IV-B 45.94

GROUP V 49.53

Group VI-A 57.96

GROUP VI-B

Utility Man 47.00

Warehouse Man 49.26

An additional 20% to wage when required to wear protective equipment on hazardous/toxic waste projects.

Engineers operating cranes with booms 100 feet but less than 149 feet in length will be paid an additional \$2.00 per hour.

Engineers operating cranes with booms 149 feet or over in length will be paid an additional \$3.00 per hour.

Loader operators over 5 cubic yard capacity additional .50 per hour.

Shovel operators over 4 cubic yard capacity additional \$1.00 per hour.

**SUPPLEMENTAL BENEFITS**

Per hour:

Journeyworker \$ 32.32

**OVERTIME PAY**

See (B, E, Q, V) on OVERTIME PAGE

**HOLIDAY**

Paid: See (5, 6, 8, 15, 25, 26) on HOLIDAY PAGE

Overtime: See (5, 6, 8, 15, 25, 26) on HOLIDAY PAGE

8-137B

**Operating Engineer - Heavy&Highway**

**09/01/2024**

**JOB DESCRIPTION** Operating Engineer - Heavy&Highway

**DISTRICT 8**

**ENTIRE COUNTIES**

Putnam, Westchester

**PARTIAL COUNTIES**

Dutchess: All the counties of Westchester and Putnam and the southern part of Dutchess County defined by the northern boundary line of the City of Poughkeepsie, then due east to Route 115, then north along Route 115 to Bedell Road, then east along Bedell Road to Van Wagner Road, then north along Van Wagner Road to Bower Road, then east along Bower Road to Route 44 and along Route 44 east to Route 343, then along Route 343 east to the northern boundary of Town of Dover Plains and east along the northern boundary of Town of Dover Plains to the border line of the State of Connecticut and bordered on the west by the middle of the Hudson River.

**WAGES**

GROUP I: Boom Truck, Cherry Picker, Clamshell, Crane, (Crawler, Truck), Dragline, Drill Rig (Casa Grande, Cat, or Similar), Floating Crane (Crane on Barges) under 100 tons, Gin Pole, Hoist Engineer-Concrete (Crane-Derrick-Mine Hoist), Knuckle Boom Crane, Rough Terrain Crane.

GROUP I-A: Auger (Truck or Truck Mounted), Boat Captain, Bulldozer-All Sizes, Central Mix Plant Operator, Chipper (all types), Close Circuit T.V., Combination Loader/Backhoe, Compactor with Blade, Concrete Finishing Machine, Gradall, Grader (Motor Grader), Elevator & Cage (Materials or Passenger), Excavator (and all attachments), Front End Loaders (1 1/2 yards and over), High Lift Lull and similar, Hoist (Single, Double, Triple Drum), Hoist Portable Mobile Unit, Hoist Engineer (Material), Jack and Bore Machine, Log Skidders, Mill Machines, Mucking Machines, Overhead Crane, Paver (concrete), Post Pounder (of any type), Push Cats, Road Reclaimer, Robot Hammer (Brokk or similar), Robotic Equipment (Scope of Engineer Schedule), Ross Carrier and similar, Scrapers (20 yard struck and over), Side Boom, Slip Form Machine, Spreader (Asphalt), Trenching Machines (Telephies-Vermeer Concrete Saw), Tractor Type Demolition Equipment, Vacuum Truck, Vibratory Roller(Riding) or Roller used in mainline paving operations.

GROUP I-B: Asphalt Mobile Conveyor/Transfer Machine, Road Paver (Asphalt).

GROUP II-A: Ballast Regulators, Compactor Self Propelled, Fusion Machine, Rail Anchor Machines, Roller (4 ton and over), Scrapers (20 yard struck and under).

GROUP II-B: Mechanic (Outside) All Types, Shop Mechanic.

GROUP III: Air Tractor Drill, Asphalt Plant, Batch Plant, Boiler (High Pressure), Concrete Breaker (Track or Rubber Tire), Concrete Pump, Concrete Spreader, Excavator Drill, Farm Tractor, Forklift (all types), Gas Tapping (Live), Hydroseeder, Loader (1 1/2 yards and under), Locomotive (all sizes), Machine Pulling Sheeps Foot Roller, Portable Asphalt Plant, Portable Batch Plant, Portable Crusher (Apprentice), Powerhouse Plant, Roller (under 4 ton), Sheer Excavator, Skid Steer/Bobcat, Stone Crusher, Sweeper (with seat), Well Drilling Machine.

GROUP IV: Service Person (Grease Truck), Deckhand.

GROUP IV-B: Conveyor Belt Machine (Truck Mounted), Heater (all types), Lighting Unit (Portable), Maintenance Engineer (For Crane Only), Mechanics Helper, Pump (Fireproofing), Pumps-Pump Station/Water/Sewer/Gypsum/Plaster, etc., Pump Truck (Sewer Jet or Similar), Welders Helper, Welding Machine (Steel Erection), Well Point System.

GROUP V: All Tower Cranes-All Climbing Cranes and all cranes of 100-ton capacity or greater (3900 Manitowac or similar) irrespective of manufacturer and regardless of how the same is rigged, Hoist Engineer (Steel), Engineer-Pile Driver, Jersey Spreader, Pavement Breaker/Post Hole Digger.

WAGES: Per hour: 07/01/2024

Group I	\$ 68.63
Group I-A	60.42
Group I-B	63.70
Group II-A	57.84
Group II-B	59.67
Group III	56.81
Group IV	51.57
Group IV-B	44.19
Group V	
Engineer All Tower, Climbing and	
Cranes of 100 Tons	77.82
Hoist Engineer(Steel)	70.41
Engineer(Pile Driver)	75.13
Jersey Spreader, Pavement Breaker (Air	
Ram)Post Hole Digger	59.19

Engineers operating cranes with booms 100 feet but less than 149 feet in length will be paid an additional \$2.00 per hour over the rate listed in the Wage Schedule. Engineers operating cranes with booms 149 feet or over in length will be paid an additional \$3.00 per hour over the rate listed in the Wage Schedule. Loader and Excavator Operators: over 5 cubic yards capacity \$0.50 per hour over the rate listed in the Wage Schedule. Shovel Operators: over 4 cubic yards capacity \$1.00 per hour over the rate listed in the Wage Schedule.

#### SHIFT WORK

A 15% premium on all hours paid, including overtime hours for 2nd, 3rd shifts on all government mandated off-shift work

#### SUPPLEMENTAL BENEFITS

Per hour:

Journeyworker: \$ 34.85 up  
to 40 Hours

After 40 hours  
\$ 25.55\* PLUS

\$ 1.25 on all  
hours worked

\*This amount is subject to premium

**OVERTIME PAY**

See (B, E, P, \*R, \*\*U) on OVERTIME PAGE

**HOLIDAY**

Paid: See (5, 6, 8, 15, 25, 26) on HOLIDAY PAGE

Overtime..... See ( 5, 6, 8, 15, 25, 26 ) on OVERTIME PAGE

\* For Holiday codes 8,15,25,26 code R applies

\*\* For Holiday Codes 5 & 6 code U applies

Note: If employees are required to work on Easter Sunday they shall be paid at the rate of triple time.

**REGISTERED APPRENTICES**

(1)year terms at the following rate.

1st term	\$ 30.21
2nd term	36.25
3rd term	42.30
4th term	48.34
Supplemental Benefits per hour:	

26.85

8-137HH

**Operating Engineer - Heavy&Highway**

**09/01/2024**

**JOB DESCRIPTION** Operating Engineer - Heavy&Highway

**DISTRICT** 9

**ENTIRE COUNTIES**

Putnam, Westchester

**PARTIAL COUNTIES**

Dutchess: South of the North city line of Poughkeepsie

**WAGES**

Party Chief - One who directs a survey party

Instrument Man - One who runs the instrument and assists Party Chief

Rodman - One who holds the rod and in general, assists the Survey Crew

Categories cover GPS & Underground Surveying

Per Hour: 07/01/2024

Party Chief	\$ 84.94
Instrument Man	63.15
Rodman	53.43

**SUPPLEMENTAL BENEFITS**

Per Hour: 07/01/2024

All Categories  
Straight Time: \$ 30.04\* + \$7.64

Premium:  
Time & 1/2 \$ 45.06\* + \$7.64

Double Time \$ 60.08\* + \$7.64

Non-Worked Holiday Supplemental Benefits:  
\$ 21.83

**OVERTIME PAY**

See (B, \*E, Q) on OVERTIME PAGE

\* Doubletime paid on all hours in excess of 8 hours on Saturday

**HOLIDAY**

Paid: See (5, 6, 7, 11, 12) on HOLIDAY PAGE

Overtime: See (5, 6, 7, 11, 12) on HOLIDAY PAGE

9-15Dh

**Operating Engineer - Heavy&Highway - Tunnel**

**09/01/2024**

**JOB DESCRIPTION** Operating Engineer - Heavy&Highway - Tunnel

**DISTRICT** 8

**ENTIRE COUNTIES**

Putnam, Westchester

**PARTIAL COUNTIES**

Dutchess: All the counties of Westchester and Putnam and the southern part of Dutchess County defined by the northern boundary line of the City of Poughkeepsie, then due east to Route 115, then north along Route 115 to Bedell Road, then east along Bedell Road to Van Wagner Road, then north along Van Wagner Road to Bower Road, then east along Bower Road to Route 44 and along Route 44 east to Route 343, then along Route 343 east to the northern boundary of Town of Dover Plains and east along the northern boundary of Town of Dover Plains to the border line of the State of Connecticut and bordered on the west by the middle of the Hudson River.

**WAGES**

GROUP I: Boom Truck, Cherry Picker, Clamshell, Crane(Crawler, Truck), Dragline, Drill Rig Casa Grande(Cat or Similar), Floating Crane(Crane on Barge-Under 100 Tons), Hoist Engineer(Concrete/Crane-Derrick-Mine Hoist), Knuckle Boom Crane, Rough Terrain Crane.

GROUP I-A: Auger(Truck or Truck Mounted), Boat Captain, Bull Dozer-all sizes, Central Mix Plant Operator, Chipper-all types, Close Circuit T.V., Combination Loader/Backhoe, Compactor with Blade, Concrete Finishing Machine, Gradall, Grader(Motor Grader), Elevator & Cage(Materials or Passengers), Excavator(and all attachments), Front End Loaders(1 1/2 yards and over), High Lift Lull, Hoist(Single, Double, Triple Drum), Hoist Portable Mobile Unit, Hoist Engineer(Material), Jack and Bore Machine, Log Skidder, Milling Machine, Moveable Concrete Barrier Transfer & Transport Vehicle, Mucking Machines. Overhead Crane, Paver(Concrete), Post Pounder of any type, Push Cats, Road Reclaimer, Robot Hammer(Brokk or similar), Robotic Equipment(Scope of Engineer Schedule), Ross Carrier and similar machines, Scrapers(20 yards struck and over), Side Boom, Slip Form Machine, Spreader(Asphalt), Trenching Machines, Telephies-Vermeer Concrete Saw, Tractor type demolition equipment, Vacuum Truck, Vibratory Roller (Riding) used in mainline paving operations.

GROUP I-B: Asphalt Mobile Conveyor/Transfer Machine, Road Paver(Asphalt).

GROUP II-A: Ballast Regulators, Compactor(Self-propelled), Fusion Machine, Rail Anchor Machines, Roller(4 ton and over), Scrapers(20 yard struck and under).

GROUP II-B: Mechanic(outside)all types, Shop Mechanic.

GROUP III: Air Tractor Drill, Asphalt Plant, Batch Plant, Boiler(High Pressure), Concrete Breaker(Track or Rubber Tire), Concrete Pump, Concrete Spreader, Excavator Drill, Farm Tractor, Forklift(all types of power), Gas Tapping(Live), Hydroseeder, Loader(1 1/2 yards and under), Locomotive(all sizes), Machine Pulling Sheeps Foot Roller, Portable Asphalt Plant, Portable Batch Plant, Portable Crusher(Apprentice), Powerhouse Plant, Roller(under 4 ton), Sheer Excavator, Skidsteer/Bobcat, Stone Crusher, Sweeper(with seat), Well Drilling Machine.

GROUP IV-A: Service Person(Grease Truck), Deckhand.

GROUP IV-B: Conveyor Belt Machine(Truck Mounted), Heater(all types), Lighting Unit(Portable), Maintenance Engineer(for Crane only), Mechanics Helper, Pump(Fireproofing), Pumps-Pump Station/Water/Sewer/Gypsum/Plaster, etc., Pump Truck(Sewer Jet or similar), Welding Machine(Steel Erection), Welders Helper.

GROUP V-A: Engineer(all Tower Cranes, all Climbing Cranes & all Cranes of 100 ton capacity or greater),Hoist Engineer(Steel-Sub Structure), Engineer-Pile Driver, Jersey-Spreader, Pavement breaker, Post Hole Digger

WAGES: (per hour)

07/01/2024

GROUP I	\$ 68.63
GROUP I-A	60.42
GROUP I-B	63.70
GROUP II-A	57.84
GROUP II-B	59.67
GROUP III	56.81
GROUP IV-A	51.57
GROUP IV-B	44.19
GROUP V-A	
Engineer-Cranes	77.82
Engineer-Pile Driver	75.13
Hoist Engineer	70.41
Jersey Spreader/Post Hole Digger	59.19

An additional 20% to wage when required to wear protective equipment on hazardous/toxic waste projects. Operators required to use two buckets pouring concrete on other than road pavement shall receive \$0.50 per hour over scale. Engineers operating cranes with booms 100 feet but less than 149 feet in length will be paid an additional \$2.00 per hour. Engineers operating cranes with booms 149 feet or over in length will be paid an additional \$3.00 per hour. Operators of shovels with a capacity over (4) cubic yards shall be paid an additional \$1.00 per hour. Operators of loaders with a capacity over (5) cubic yards shall be paid an additional \$0.50 per hour.

### SHIFT WORK

A 15% premium on all hours paid, including overtime hours for 2nd, 3rd shifts  
on all government mandated off-shift work

### SUPPLEMENTAL BENEFITS

Per hour:

Journeyworker:

\$ 34.85 up to  
40 hours  
After 40 hours  
\$25.55 plus  
\$1.25 on all  
hours worked

### OVERTIME PAY

See (D, O, \*U, V) on OVERTIME PAGE

### HOLIDAY

Paid: See (5, 6, 8, 15, 25, 26) on HOLIDAY PAGE

Overtime: See (5, 6, 8, 15, 25, 26) on HOLIDAY PAGE

\* Note: For Holiday codes 5 & 6, code U applies. For Holiday codes 8, 15, 25, 26, code R applies.

Note: If employees are required to work on Easter Sunday, they shall be paid at the rate of triple time.

### REGISTERED APPRENTICES

(1)year terms at the following rates:

1st term	\$ 30.21
2nd term	36.25
3rd term	42.30
4th term	48.34

Supplemental Benefits per hour:

All terms	\$ 26.85
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8-137Tun

## Operating Engineer - Marine Dredging

09/01/2024

**JOB DESCRIPTION** Operating Engineer - Marine Dredging

**DISTRICT** 4

### ENTIRE COUNTIES

Albany, Bronx, Cayuga, Clinton, Columbia, Dutchess, Essex, Franklin, Greene, Jefferson, Kings, Monroe, Nassau, New York, Orange, Oswego, Putnam, Queens, Rensselaer, Richmond, Rockland, St. Lawrence, Suffolk, Ulster, Washington, Wayne, Westchester

### WAGES

These wages do not apply to Operating Engineers on land based construction projects. For those projects, please see the Operating Engineer Heavy/Highway Rates. The wage rates below for all equipment and operators are only for marine dredging work in navigable waters found in the counties listed above.

Per Hour: 07/01/2024

CLASS A1 \$ 45.26

Deck Captain, Leverman,  
Mechanical Dredge Operator,  
Licensed Tug Operator 1000HP or more.

CLASS A2 40.33

Crane Operator (360 swing)

CLASS B To conform to Operating Engineer  
Dozer, Front Loader Prevailing Wage in locality where work  
Operator on Land is being performed including benefits.

CLASS B1 39.14

Derrick Operator (180 swing)  
Spider/Spill Barge Operator



Operator II, Fill Placer, Engineer  
Chief Mate, Electrician, Chief Welder,  
Maintenance Engineer, Licensed Boat, Crew Boat Operator

CLASS B2 36.84  
Certified Welder

CLASS C1 35.83  
Drag Barge Operator,  
Steward, Mate,  
Assistant Fill Placer

CLASS C2 34.68  
Boat Operator

CLASS D 28.81  
Shoreman, Deckhand, Oiler,  
Rodman, Scowman, Cook,  
Messman, Porter/Janitor

#### **SUPPLEMENTAL BENEFITS**

Per Hour:

THE FOLLOWING SUPPLEMENTAL BENEFITS APPLY TO ALL CATEGORIES

All Classes A & B \$ 12.00 plus 7%  
of straight time  
wage, Overtime hours  
add \$ 0.63

All Class C & D \$ 11.75 plus 7%  
of straight time  
wage, Overtime hours  
add \$ 0.50

#### **OVERTIME PAY**

See (B2, F, R) on OVERTIME PAGE

#### **HOLIDAY**

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6, 8, 15, 26) on HOLIDAY PAGE

4-25a-MarDredge

### **Operating Engineer - Survey Crew - Consulting Engineer**

**09/01/2024**

**JOB DESCRIPTION** Operating Engineer - Survey Crew - Consulting Engineer

**DISTRICT** 9

#### **ENTIRE COUNTIES**

Bronx, Kings, Nassau, New York, Putnam, Queens, Richmond, Suffolk, Westchester

#### **PARTIAL COUNTIES**

Dutchess: That part in Dutchess County lying South of the North City line of Poughkeepsie.

#### **WAGES**

Feasibility and preliminary design surveying, any line and grade surveying for inspection or supervision of construction.

Per hour: 07/01/2024  
Survey Classifications

Party Chief \$ 49.39  
Instrument Man 40.96  
Rodman 35.63

#### **SUPPLEMENTAL BENEFITS**

Per Hour:

All Crew Members: \$ 23.75

#### **OVERTIME PAY**

OVERTIME:.... See ( B, E\*, Q, V ) ON OVERTIME PAGE.

\*Double-time paid on the 9th hour on Saturday.

#### **HOLIDAY**

Paid: See (5, 6, 7, 11, 16) on HOLIDAY PAGE

Overtime: See (5, 6, 7, 11, 16) on HOLIDAY PAGE

**Painter**

**09/01/2024**

**JOB DESCRIPTION** Painter

**DISTRICT 8**

**ENTIRE COUNTIES**

Bronx, Kings, Nassau, New York, Putnam, Queens, Richmond, Suffolk, Westchester

**WAGES**

Per hour:	07/01/2024	05/01/2025 Additional
Brush	52.86*	\$ 2.62**
Abatement/Removal of lead based or lead containing paint on materials to be repainted.	52.86*	
Spray & Scaffold	\$ 55.86*	
Fire Escape	55.86*	
Decorator	55.86*	
Paperhanger/Wall Coverer	55.09*	

\*Subtract \$ 0.10 to calculate premium rate.

\*\* To be allocated at a later date.

**SHIFT WORK**

Counties of Nassau, Putnam, Suffolk & Westchester; Agency/Government mandated off-shift work to be paid at time and one-half the hourly wage.

**SUPPLEMENTAL BENEFITS**

Per hour:

Paperhanger	\$ 36.73
All others	34.31
Premium	38.28**

\*\*Applies only to "All others" category, not paperhanger journeyworker.

**OVERTIME PAY**

See (A, E, R) on OVERTIME PAGE

**HOLIDAY**

Paid: See (1) on HOLIDAY PAGE  
Overtime: See (5, 6, 16, 25) on HOLIDAY PAGE

**REGISTERED APPRENTICES**

One ( 1 ) year terms at the following wage rate.

Per hour:	07/01/2024
Appr 1st term...	\$ 20.22*
Appr 2nd term...	25.93*
Appr 3rd term...	31.61*
Appr 4th term...	42.40*

\*Subtract \$ 0.10 to calculate premium rate.

Supplemental benefits:

Per Hour:	
Appr 1st term...	\$ 16.89
Appr 2nd term...	20.95
Appr 3rd term...	24.10
Appr 4th term...	30.57

8-NYDC9-B/S

**Painter**

**09/01/2024**

**JOB DESCRIPTION** Painter

**DISTRICT 8**

**ENTIRE COUNTIES**

Putnam, Suffolk, Westchester

### PARTIAL COUNTIES

Nassau: All of Nassau except the areas described below: Atlantic Beach, Ceaderhurst, East Rockaway, Gibson, Hewlett, Hewlett Bay, Hewlett Neck, Hewlett Park, Inwood, Lawrence, Lido Beach, Long Beach, parts of Lynbrook, parts of Oceanside, parts of Valley Stream, and Woodmere. Starting on the South side of Sunrise Hwy in Valley Stream running east to Windsor and Rockaway Ave., Rockville Centre is the boundary line up to Lawson Blvd. turn right going west all the above territory. Starting at Union Turnpike and Lakeville Rd. going north to Northern Blvd. the west side of Lakeville road to Northern blvd. At Northern blvd. going east the district north of Northern blvd. to Port Washington Blvd. West of Port Washington blvd. to St. Francis Hospital then north of first traffic light to Port Washington and Sands Point, Manor HAVen, Harbour Acres.

### WAGES

Per hour:	07/01/2024	05/01/2025
Drywall Taper:	\$ 52.86*	Additional
Scaffold:	\$ 55.86*	\$ 2.62**

\*Subtract \$ 0.10 to calculate premium rate.

\*\* To be allocated a later date.

### SHIFT WORK

Agency/Government mandated off-shift work to be paid at time and one-half hourly wage

### SUPPLEMENTAL BENEFITS

Per hour:	
Journeyman	\$ 34.31

### OVERTIME PAY

See (A, E, R) on OVERTIME PAGE

### HOLIDAY

Paid:	See (1) on HOLIDAY PAGE
Overtime:	See (5, 6, 16, 25) on HOLIDAY PAGE

### REGISTERED APPRENTICES

Wages - Per Hour:

1500 hour terms at the following wage rate:

1st term	\$ 20.22*
2nd term	25.93*
3rd term	31.61*
4th term	42.40*

\*Subtract \$ 0.10 to calculate premium rate.

Supplemental Benefits - Per hour:

One year term (1500 hours) at the following dollar amount.

1st year	\$ 16.89
2nd year	20.95
3rd year	24.10
4th year	30.57

8-NYDCT9-DWT

### Painter - Bridge & Structural Steel

09/01/2024

**JOB DESCRIPTION** Painter - Bridge & Structural Steel

**DISTRICT** 8

### ENTIRE COUNTIES

Albany, Bronx, Clinton, Columbia, Dutchess, Essex, Franklin, Fulton, Greene, Hamilton, Kings, Montgomery, Nassau, New York, Orange, Putnam, Queens, Rensselaer, Richmond, Rockland, Saratoga, Schenectady, Schoharie, Suffolk, Sullivan, Ulster, Warren, Washington, Westchester

### WAGES

Per Hour:	
STEEL:	
Bridge Painting:	07/01/2024
	\$ 56.00
	+ 10.35*

ADDITIONAL \$7.00 per hour for POWER TOOL/SPRAY, whether straight time or overtime.

NOTE: All premium wages are to be calculated on base rate per hour only.

\* For the period of May 1st to November 15th, this amount is payable up to 40 hours. For the period of Nov 16th to April 30th, this amount is payable up to 50 hours. EXCEPTION: First and last week of employment, and for the weeks of Memorial Day, Independence Day and Labor Day, where the amount is paid for the actual number of hours worked (50 hour cap).

NOTE: Generally, for Bridge Painting Contracts, ALL WORKERS on and off the bridge (including Flagmen) are to be paid Painter's Rate; the contract must be ONLY for Bridge Painting.

### SHIFT WORK

When directly specified in public agency or authority contract documents for an employer to work a second shift and works the second shift with employees other than from the first shift, all employees who work the second shift will be paid 10% of the base wage shift differential in lieu of overtime for the first eight (8) hours worked after which the employees shall be paid at time and one half of the regular wage rate. When a single irregular work shift is mandated in the job specifications or by the contracting agency, wages shall be paid at time and one half for single shifts between the hours of 3pm-11pm or 11pm-7am.

### SUPPLEMENTAL BENEFITS

Per Hour:

Journeyworker:

\$ 12.43  
+ 31.55\*

\* For the period of May 1st to November 15th, this amount is payable up to 40 hours. For the period of Nov 16th to April 30th, this amount is payable up to 50 hours. EXCEPTION: First and last week of employment, and for the weeks of Memorial Day, Independence Day and Labor Day, where the amount is paid for the actual number of hours worked (50 hour cap).

### OVERTIME PAY

See (B, F, R) on OVERTIME PAGE

### HOLIDAY

Paid: See (1) on HOLIDAY PAGE  
Overtime: See (4, 6) on HOLIDAY PAGE

### REGISTERED APPRENTICES

Wage - Per hour:

Apprentices: (1) year terms.

1st year	\$ 22.40 + 4.14
2nd year	\$ 33.60 + 6.21
3rd year	\$ 44.80 + 8.28
Supplemental Benefits - Per hour:	
1st year	\$ 1.16 + 12.62
2nd year	\$ 7.46 + 18.93
3rd year	\$ 9.94 + 25.24

NOTE: All premium wages are to be calculated on base rate per hour only.

8-DC-9/806/155-BrSS

### Painter - Line Striping

09/01/2024

**JOB DESCRIPTION** Painter - Line Striping

**DISTRICT** 8

### ENTIRE COUNTIES

Albany, Clinton, Columbia, Dutchess, Essex, Franklin, Fulton, Greene, Hamilton, Montgomery, Nassau, Orange, Putnam, Rensselaer, Rockland, Saratoga, Schenectady, Schoharie, Suffolk, Sullivan, Ulster, Warren, Washington, Westchester

### WAGES

Per hour:

Painter (Striping-Highway):	07/01/2024	04/01/2025	04/01/2026
Striping-Machine Operator*	\$ 34.12	\$ 35.49	\$ 36.93

Linerman Thermoplastic	41.12	42.74	44.44
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Note: \* Includes but is not limited to: Positioning of cones and directing of traffic using hand held devices. Excludes the Driver/Operator of equipment used in the maintenance and protection of traffic safety.

#### SHIFT WORK

When directly specified in public agency or authority contract documents there shall be a 30% night shift premium pay differential for all work performed after 9:00pm and before 5:00am.

#### SUPPLEMENTAL BENEFITS

Per hour paid:

Journeyworker:

Striping Machine Operator: \$23.65 \$ 24.30 \$ 24.95

Linerman Thermoplastic: 23.65 24.30 24.95

#### OVERTIME PAY

See (B, B2, E2, F, S) on OVERTIME PAGE

#### HOLIDAY

Paid: See (5, 20) on HOLIDAY PAGE

Overtime: See (5, 20) on HOLIDAY PAGE

#### REGISTERED APPRENTICES

One (1) year terms at the following wage rates:

1st Term:	\$ 16.00	\$ 16.00	\$ 16.00
2nd Term:	20.47	21.29	22.16
3rd Term:	27.30	28.39	29.54

Supplemental Benefits per hour:

All terms:	\$ 23.65	\$ 24.30	\$ 24.95
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8-1456-LS

#### Painter - Metal Polisher

09/01/2024

#### JOB DESCRIPTION Painter - Metal Polisher

DISTRICT 8

#### ENTIRE COUNTIES

Albany, Allegany, Bronx, Broome, Cattaraugus, Cayuga, Chautauqua, Chemung, Chenango, Clinton, Columbia, Cortland, Delaware, Dutchess, Erie, Essex, Franklin, Fulton, Genesee, Greene, Hamilton, Herkimer, Jefferson, Kings, Lewis, Livingston, Madison, Monroe, Montgomery, Nassau, New York, Niagara, Oneida, Onondaga, Ontario, Orange, Orleans, Oswego, Otsego, Putnam, Queens, Rensselaer, Richmond, Rockland, Saratoga, Schenectady, Schoharie, Schuyler, Seneca, St. Lawrence, Steuben, Suffolk, Sullivan, Tioga, Tompkins, Ulster, Warren, Washington, Wayne, Westchester, Wyoming, Yates

#### WAGES

07/01/2024

Metal Polisher \$ 39.33

Metal Polisher\* 40.43

Metal Polisher\*\* 43.33

\*Note: Applies on New Construction & complete renovation

\*\* Note: Applies when working on scaffolds over 34 feet.

#### SUPPLEMENTAL BENEFITS

Per Hour: 07/01/2024

Journeyworker:

All classification \$ 12.79

#### OVERTIME PAY

See (B, E, P, T) on OVERTIME PAGE

#### HOLIDAY

Paid: See (5, 6, 11, 15, 16, 25, 26) on HOLIDAY PAGE

Overtime: See (5, 6, 11, 15, 16, 25, 26) on HOLIDAY PAGE

#### REGISTERED APPRENTICES

Wages per hour:

One (1) year term at the following wage rates:

07/01/2024

1st year \$ 19.67

2nd year 21.63

3rd year	23.60
1st year*	\$ 22.06
2nd year*	22.07
3rd year*	24.14
1st year**	\$ 22.17
2nd year**	24.13
3rd year**	26.10

\*Note: Applies on New Construction & complete renovation

\*\* Note: Applies when working on scaffolds over 34 feet.

Supplemental benefits:

Per hour:

1st year	\$ 8.69
2nd year	8.69
3rd year	8.69

8-8A/28A-MP

## Plumber

09/01/2024

**JOB DESCRIPTION** Plumber

**DISTRICT** 8

### ENTIRE COUNTIES

Putnam, Westchester

### WAGES

Per hour:

07/01/2024

Plumber and

Steamfitter

\$ 63.76

### SHIFT WORK

SHIFT WORK:

When directly specified in public agency or authority contract documents, shift work outside the regular hours of work shall be comprised of eight (8) hours per shift not including Saturday, Sundays and holidays. One half (1/2) hour shall be allowed for lunch after the first four (4) hours of each shift. Wage and Fringes for shift work shall be straight time plus a shift premium of twenty-five (25%) percent. A minimum of five days Monday through Friday must be worked to establish shift work.

### SUPPLEMENTAL BENEFITS

Per hour:

Journeyworker \$ 43.61

### OVERTIME PAY

See (B, E, E2, Q, V) on OVERTIME PAGE

OVERTIME:.... See on OVERTIME PAGE.

### HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6, 8, 16, 25) on HOLIDAY PAGE

### REGISTERED APPRENTICES

(1)year terms at the following wages:

1st Term	\$ 23.75
2nd Term	27.23
3rd Term	31.47
4th Term	44.80
5th Term	48.05

Supplemental Benefits per hour:

1st term	\$ 17.94
2nd term	20.05
3rd term	23.82
4th term	31.51
5th term	33.42

8-21.1-ST

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**Plumber - HVAC / Service****09/01/2024**

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**JOB DESCRIPTION** Plumber - HVAC / Service**DISTRICT** 8**ENTIRE COUNTIES**

Dutchess, Putnam, Westchester

**PARTIAL COUNTIES**

Delaware: Only the townships of Middletown and Roxbury

Ulster: Entire County(including Wallkill and Shawangunk Prisons) except for remainder of Town of Shawangunk and Towns of Plattekill, Marlboro, and Wawarsing.

**WAGES**

Per hour: 07/01/2024

HVAC Service \$ 43.43  
+ \$ 4.47\*

\*This portion of the benefit is NOT subject to the SAME PREMIUM as shown for overtime.

**SUPPLEMENTAL BENEFITS**

Per hour:

Journeyworker HVAC Service  
\$ 30.39**OVERTIME PAY**

See (B, F, R) on OVERTIME PAGE

**HOLIDAY**

Paid: See (5, 6, 16, 25) on HOLIDAY PAGE

Overtime: See (5, 6, 16, 25) on HOLIDAY PAGE

**REGISTERED APPRENTICES**

HVAC SERVICE

(1)year terms at the following wages:

1st yr.	2nd yr.	3rd yr.	4th yr.	5th yr.
\$ 19.66	\$ 23.32	\$ 29.05	\$ 35.73	\$ 38.83
+\$2.43*	+\$2.76*	+\$3.31*	+\$3.96*	+\$4.21*

\*This portion of the benefit is NOT subject to the SAME PREMIUM as shown for overtime.

Supplemental Benefits per hour:

Apprentices 07/01/2024

1st term	\$ 21.47
2nd term	23.05
3rd term	24.76
4th term	27.13
5th term	28.81

8-21.1&amp;2-SF/Re/AC

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**Plumber - Jobbing & Alterations****09/01/2024**

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**JOB DESCRIPTION** Plumber - Jobbing & Alterations**DISTRICT** 8**ENTIRE COUNTIES**

Dutchess, Putnam, Westchester

**PARTIAL COUNTIES**

Ulster: Entire county (including Wallkill and Shawangunk Prisons in Town of Shawangunk) EXCEPT for remainder of Town of Shawangunk, and Towns of Plattekill, Marlboro, and Wawarsing.

**WAGES**

Per hour: 07/01/2024

Journeyworker: \$ 49.63

Repairs, replacements and alteration work is any repair or replacement of a present plumbing system that does not change existing roughing or water supply lines.

**SHIFT WORK**

When directly specified in public agency or authority contract documents, shift work outside the regular hours of work shall be comprised of eight (8) hours per shift not including Saturday, Sundays and holidays. One half (1/2) hour shall be allowed for lunch after the first four (4) hours of each shift. Wage and Fringes for shift work shall be straight time plus a shift premium of twenty-five (25%) percent. A minimum of five days Monday through Friday must be worked to establish shift work.

#### SUPPLEMENTAL BENEFITS

Per hour:

Journeyworker

\$ 36.44

#### OVERTIME PAY

See (B, \*E, E2, Q, V) on OVERTIME PAGE

\*When used as a make-up day, hours after 8 on Saturday shall be paid at time and one half.

#### HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6, 8, 16, 25) on HOLIDAY PAGE

#### REGISTERED APPRENTICES

(1) year terms at the following wages:

1st year	\$ 21.35
2nd year	23.73
3rd year	25.87
4th year	36.28
5th year	38.34

Supplemental Benefits per hour:

1st year	\$ 12.11
2nd year	14.21
3rd year	18.38
4th year	24.86
5th year	26.96

8-21.3-J&A

#### Roofer

09/01/2024

**JOB DESCRIPTION** Roofer

**DISTRICT** 9

#### ENTIRE COUNTIES

Bronx, Dutchess, Kings, New York, Orange, Putnam, Queens, Richmond, Rockland, Sullivan, Ulster, Westchester

#### WAGES

Per Hour: 07/01/2024

Roofer/Waterproofer \$ 48.50  
+ \$7.00\*

\* This portion is not subjected to overtime premiums.

Note: Abatement/Removal of Asbestos containing roofs and roofing material is classified as Roofer.

#### SUPPLEMENTAL BENEFITS

Per Hour: \$ 31.87

#### OVERTIME PAY

See (B, H) on OVERTIME PAGE

Note: An observed holiday that falls on a Sunday will be observed the following Monday.

#### HOLIDAY

Overtime: See (5, 6) on HOLIDAY PAGE

#### REGISTERED APPRENTICES

( 1 ) year term apprentices indentured prior to 01/01/2023

1st	2nd	3rd	4th
\$ 16.97	\$ 24.25	\$ 29.10	\$ 36.37
	+ 3.50*	+ 4.20*	+ 5.26*

Supplements:

1st	2nd	3rd	4th
\$ 4.10	\$ 16.17	\$ 19.31	\$ 24.02

\* This portion is not subjected to overtime premiums.

(1) year term apprentices indentured after 01/01/2023



	1st	2nd	3rd	4th	5th
	\$ 18.43	\$ 21.82	\$ 24.25	\$ 29.10	\$ 36.37
		+ 3.16*	+ 3.50*	+ 4.20*	+ 5.26
Supplements:					
	1st	2nd	3rd	4th	5th
	\$ 7.73	\$ 14.59	\$ 16.17	\$ 19.31	\$ 24.02

\* This portion is not subjected to overtime premiums.

9-8R

<b>Sheetmetal Worker</b>	<b>09/01/2024</b>
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**JOB DESCRIPTION** Sheetmetal Worker

**DISTRICT** 8

**ENTIRE COUNTIES**

Dutchess, Orange, Putnam, Rockland, Sullivan, Ulster, Westchester

**WAGES**

	07/01/2024
SheetMetal Worker	\$ 49.51
	+ 3.71*

\*This portion of the benefit is NOT subject to the SAME PREMIUM as shown for overtime.

**SHIFT WORK**

For all NYS D.O.T. and other Governmental mandated off-shift work:

10% increase for additional shifts for a minimum of five (5) days

**SUPPLEMENTAL BENEFITS**

Journeyworker \$ 46.20

**OVERTIME PAY**

OVERTIME:.. See ( B, E, Q, ) on OVERTIME PAGE.

**HOLIDAY**

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6, 8, 15, 16, 23) on HOLIDAY PAGE

**REGISTERED APPRENTICES**

1st	2nd	3rd	4th	5th	6th	7th	8th
\$ 20.20	\$ 20.81	\$ 23.12	\$ 25.42	\$ 27.74	\$ 30.08	\$ 32.86	\$ 35.63
+ 1.48*	+ 1.67*	+ 1.86*	+ 2.04*	+ 2.23*	+ 2.41*	+ 2.60*	+ 2.78*

\*This portion of the benefit is NOT subject to the SAME PREMIUM as shown for overtime.

Supplemental Benefits per hour:

**Apprentices**

1st term	\$ 18.07
2nd term	22.24
3rd term	24.71
4th term	27.21
5th term	29.67
6th term	32.12
7th term	34.12
8th term	36.15

8-38

<b>Sheetmetal Worker</b>	<b>09/01/2024</b>
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**JOB DESCRIPTION** Sheetmetal Worker

**DISTRICT** 4

**ENTIRE COUNTIES**

Bronx, Kings, Nassau, New York, Queens, Richmond, Rockland, Suffolk, Westchester

**WAGES**

Per Hour:

	07/01/2024	08/01/2024
Sign Erector	\$ 58.00	\$ 60.00

NOTE: Structurally Supported Overhead Highway Signs(See STRUCTURAL IRON WORKER CLASS)

**SUPPLEMENTAL BENEFITS**

Per Hour:	07/01/2024	08/01/2024
Sign Erector	\$ 57.12	\$ 58.31

#### OVERTIME PAY

See (B, F, S) on OVERTIME PAGE

#### HOLIDAY

Paid: See (5, 6, 10, 11, 12, 16, 25) on HOLIDAY PAGE

Overtime: See (5, 6, 10, 11, 12, 16, 25) on HOLIDAY PAGE

#### REGISTERED APPRENTICES

Per Hour:

6 month Terms at the following percentage of Sign Erectors wage rate:

1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
35%	40%	45%	50%	55%	60%	65%	70%	75%	80%

#### SUPPLEMENTAL BENEFITS

Per Hour:

07/01/2024

1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
\$ 18.27	\$ 20.75	\$ 25.22	\$ 25.70	\$ 34.66	\$ 37.74	\$ 41.65	\$ 44.78	\$ 47.93	\$ 51.04

08/01/2024

\$ 18.65	\$ 21.16	\$ 23.69	\$ 26.22	\$35.39	\$ 38.52	\$ 42.55	\$ 45.75	\$ 48.96	\$ 52.15 4-137-SE
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#### Sprinkler Fitter

09/01/2024

**JOB DESCRIPTION** Sprinkler Fitter

**DISTRICT** 1

#### ENTIRE COUNTIES

Dutchess, Orange, Putnam, Rockland, Sullivan, Ulster, Westchester

#### WAGES

Per hour 07/01/2024

Sprinkler \$ 53.34  
Fitter

#### SUPPLEMENTAL BENEFITS

Per hour

Journeyworker \$ 30.77

#### OVERTIME PAY

See (B, E, Q) on OVERTIME PAGE

#### HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6) on HOLIDAY PAGE

Note: When a holiday falls on Sunday, the following Monday shall be considered a holiday and all work performed on either day shall be at the double time rate. When a holiday falls on Saturday, the preceding Friday shall be considered a holiday and all work performed on either day shall be at the double time rate.

#### REGISTERED APPRENTICES

Wages per hour

One Half Year terms at the following wage.

1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
\$ 25.89	\$ 28.77	\$ 31.39	\$ 34.27	\$ 37.14	\$ 40.02	\$ 42.90	\$ 45.77	\$ 48.65	\$ 51.53

Supplemental Benefits per hour

1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
\$ 9.18	\$ 9.18	\$ 20.90	\$ 20.90	\$ 21.15	\$ 21.15	\$ 21.15	\$ 21.15	\$ 21.15	\$ 21.15 1-669.2

#### Teamster - Building / Heavy&Highway

09/01/2024

**JOB DESCRIPTION** Teamster - Building / Heavy&Highway

**DISTRICT** 8

## ENTIRE COUNTIES

Putnam, Westchester

## WAGES

GROUP A: Straight Trucks (6-wheeler and 10-wheeler), A-frame, Winch, Dynamite Seeding, Mulching, Agitator, Water, Attenuator, Light Towers, Cement (all types), Suburban, Station Wagons, Cars, Pick Ups, any vehicle carrying materials of any kind.

GROUP AA: Tack Coat

GROUP B: Tractor & Trailers (all types).

GROUP BB: Tri-Axle, 14 Wheeler

GROUP C: Low Boy (carrying equipment).

GROUP D: Fuel Trucks, Tire Trucks.

GROUP E: Off-road Equipment (over 40 tons): Athey Wagons, Belly Dumps, Articulated Dumps, Trailer Wagons.

GROUP F: Off-road Equipment (over 40 tons) Euclid, DJB.

GROUP G: Off-road Equipment (under 40 tons) Athey Wagons, Belly Articulated Dumps, Trailer Wagons.

GROUP H: Off-road Equipment (under 40 tons), Euclid.

GROUP HH: Off-road Equipment (under 40 tons) D.J.B.

GROUP I: Off-road Equipment (under 40 tons) Darts.

GROUP II: Off-road Equipment (under 40 tons) RXS.

WAGES:(per hour)

07/01/2024

GROUP A	\$ 47.86*
GROUP AA	50.86*
GROUP B	48.48*
GROUP BB	47.98*
GROUP C	50.61*
GROUP D	48.31*
GROUP E	48.86*
GROUP F	49.86*
GROUP G	48.61*
GROUP H	49.23*
GROUP HH	49.61*
GROUP I	49.36*
GROUP II	49.73*

\* To calculate premium wage, subtract \$ .10 from the hourly wage.

Note: Fuel truck operators on construction sites addit. \$5.00 per day.

For work on hazardous/toxic waste site addit. 20% of hourly rate.

## SHIFT WORK

When mandated by the contracting agency, DOT, or any governmental agency contracts shall receive a shift differential of fifteen (15%) above the wage rate.

## SUPPLEMENTAL BENEFITS

Per hour:

Journeyworker

First 40 hours	\$ 37.33
41st-45th hours	16.73
Over 45 hours	1.60

## OVERTIME PAY

See (B, E, P, R) on OVERTIME PAGE

## HOLIDAY

Paid: See (5, 6, 8, 15, 25) on HOLIDAY PAGE

Overtime: See (5, 6, 8, 15, 25) on HOLIDAY PAGE

8-456

**Welder**

**09/01/2024**

**JOB DESCRIPTION** Welder

**DISTRICT** 1

## ENTIRE COUNTIES

Albany, Allegany, Bronx, Broome, Cattaraugus, Cayuga, Chautauqua, Chemung, Chenango, Clinton, Columbia, Cortland, Delaware, Dutchess, Erie, Essex, Franklin, Fulton, Genesee, Greene, Hamilton, Herkimer, Jefferson, Kings, Lewis, Livingston, Madison, Monroe, Montgomery, Nassau, New York, Niagara, Oneida, Onondaga, Ontario, Orange, Orleans, Oswego, Otsego, Putnam, Queens, Rensselaer, Richmond, Rockland, Saratoga, Schenectady, Schoharie, Schuyler, Seneca, St. Lawrence, Steuben, Suffolk, Sullivan, Tioga, Tompkins, Ulster, Warren, Washington, Wayne, Westchester, Wyoming, Yates

## WAGES

Per hour 07/01/2024

Welder: To be paid the same rate of the mechanic performing the work.\*

\*EXCEPTION: If a specific welder certification is required, then the 'Certified Welder' rate in that trade tag will be paid.

**OVERTIME PAY**

**HOLIDAY**

1-As Per Trade

## Overtime Codes

Following is an explanation of the code(s) listed in the OVERTIME section of each classification contained in the attached schedule. Additional requirements may also be listed in the HOLIDAY section.

NOTE: Supplemental Benefits are 'Per hour worked' (for each hour worked) unless otherwise noted

- ( AA ) Time and one half of the hourly rate after 7 and one half hours per day
- ( A ) Time and one half of the hourly rate after 7 hours per day
- ( B ) Time and one half of the hourly rate after 8 hours per day
- ( B1 ) Time and one half of the hourly rate for the 9th & 10th hours week days and the 1st 8 hours on Saturday.  
Double the hourly rate for all additional hours
- ( B2 ) Time and one half of the hourly rate after 40 hours per week
- ( C ) Double the hourly rate after 7 hours per day
- ( C1 ) Double the hourly rate after 7 and one half hours per day
- ( D ) Double the hourly rate after 8 hours per day
- ( D1 ) Double the hourly rate after 9 hours per day
- ( E ) Time and one half of the hourly rate on Saturday
- ( E1 ) Time and one half 1st 4 hours on Saturday; Double the hourly rate all additional Saturday hours
- ( E2 ) Saturday may be used as a make-up day at straight time when a day is lost during that week due to inclement weather
- ( E3 ) Between November 1st and March 3rd Saturday may be used as a make-up day at straight time when a day is lost during that week due to inclement weather, provided a given employee has worked between 16 and 32 hours that week
- ( E4 ) Saturday and Sunday may be used as a make-up day at straight time when a day is lost during that week due to inclement weather
- ( E5 ) Double time after 8 hours on Saturdays
- ( F ) Time and one half of the hourly rate on Saturday and Sunday
- ( G ) Time and one half of the hourly rate on Saturday and Holidays
- ( H ) Time and one half of the hourly rate on Saturday, Sunday, and Holidays
- ( I ) Time and one half of the hourly rate on Sunday
- ( J ) Time and one half of the hourly rate on Sunday and Holidays
- ( K ) Time and one half of the hourly rate on Holidays
- ( L ) Double the hourly rate on Saturday
- ( M ) Double the hourly rate on Saturday and Sunday
- ( N ) Double the hourly rate on Saturday and Holidays
- ( O ) Double the hourly rate on Saturday, Sunday, and Holidays
- ( P ) Double the hourly rate on Sunday
- ( Q ) Double the hourly rate on Sunday and Holidays
- ( R ) Double the hourly rate on Holidays
- ( S ) Two and one half times the hourly rate for Holidays

- ( S1 ) Two and one half times the hourly rate the first 8 hours on Sunday or Holidays One and one half times the hourly rate all additional hours.
- ( T ) Triple the hourly rate for Holidays
- ( U ) Four times the hourly rate for Holidays
- ( V ) Including benefits at SAME PREMIUM as shown for overtime
- ( W ) Time and one half for benefits on all overtime hours.
- ( X ) Benefits payable on Paid Holiday at straight time. If worked, additional benefit amount will be required for worked hours. (Refer to other codes listed.)

## Holiday Codes

### PAID Holidays:

Paid Holidays are days for which an eligible employee receives a regular day's pay, but is not required to perform work. If an employee works on a day listed as a paid holiday, this remuneration is in addition to payment of the required prevailing rate for the work actually performed.

### OVERTIME Holiday Pay:

Overtime holiday pay is the premium pay that is required for work performed on specified holidays. It is only required where the employee actually performs work on such holidays. The applicable holidays are listed under HOLIDAYS: OVERTIME. The required rate of pay for these covered holidays can be found in the OVERTIME PAY section listings for each classification.

Following is an explanation of the code(s) listed in the HOLIDAY section of each classification contained in the attached schedule. The Holidays as listed below are to be paid at the wage rates at which the employee is normally classified.

- ( 1 ) None
- ( 2 ) Labor Day
- ( 3 ) Memorial Day and Labor Day
- ( 4 ) Memorial Day and July 4th
- ( 5 ) Memorial Day, July 4th, and Labor Day
- ( 6 ) New Year's, Thanksgiving, and Christmas
- ( 7 ) Lincoln's Birthday, Washington's Birthday, and Veterans Day
- ( 8 ) Good Friday
- ( 9 ) Lincoln's Birthday
- ( 10 ) Washington's Birthday
- ( 11 ) Columbus Day
- ( 12 ) Election Day
- ( 13 ) Presidential Election Day
- ( 14 ) 1/2 Day on Presidential Election Day
- ( 15 ) Veterans Day
- ( 16 ) Day after Thanksgiving
- ( 17 ) July 4th
- ( 18 ) 1/2 Day before Christmas
- ( 19 ) 1/2 Day before New Years
- ( 20 ) Thanksgiving
- ( 21 ) New Year's Day
- ( 22 ) Christmas
- ( 23 ) Day before Christmas
- ( 24 ) Day before New Year's
- ( 25 ) Presidents' Day
- ( 26 ) Martin Luther King, Jr. Day
- ( 27 ) Memorial Day
- ( 28 ) Easter Sunday

( 29 )      Juneteenth



**New York State Department of Labor - Bureau of Public Work**  
**State Office Building Campus**  
**Building 12 - Room 130**  
**Albany, New York 12226**

**REQUEST FOR WAGE AND SUPPLEMENT INFORMATION**

As Required by Articles 8 and 9 of the NYS Labor Law

Fax (518) 485-1870 or mail this form for new schedules or for determination for additional occupations.

**This Form Must Be Typed**

Submitted By:

(Check Only One)

☐

Contracting Agency

☐

Architect or Engineering Firm

☐

Public Work District Office

Date:

**A. Public Work Contract to be let by:** (Enter Data Pertaining to Contracting/Public Agency)

1. Name and complete address ☐ (Check if new or change)

Telephone

Fax

E-Mail:

2. NY State Units (see Item 5).

☐ 01 DOT

☐ 02 OGS

☐ 03 Dormitory Authority

☐ 04 State University  
Construction Fund

☐ 05 Mental Hygiene  
Facilities Corp.

☐ 06 OTHER N.Y. STATE UNIT

☐ 07 City

☐ 08 Local School District

☐ 09 Special Local District, i.e.,  
Fire, Sewer, Water District

☐ 10 Village

☐ 11 Town

☐ 12 County

☐ 13 Other Non-N.Y. State  
(Describe)

3. SEND REPLY TO ☐ (check if new or change)  
Name and complete address:

Telephone

Fax

E-Mail:

4. SERVICE REQUIRED. Check appropriate box and provide project information.

☐ New Schedule of Wages and Supplements.

APPROXIMATE BID DATE :

☐ Additional Occupation and/or Redetermination

PRC NUMBER ISSUED PREVIOUSLY FOR  
THIS PROJECT :

OFFICE USE ONLY

**B. PROJECT PARTICULARS**

5. Project Title

Description of Work

Contract Identification Number

Note: For NYS units, the OSC Contract No.

6. Location of Project:  
Location on Site

Route No/Street Address

Village or City

Town

County

7. Nature of Project - Check One:

☐

1. New Building

☐

2. Addition to Existing Structure

☐

3. Heavy and Highway Construction (New and Repair)

☐

4. New Sewer or Waterline

☐

5. Other New Construction (Explain)

☐

6. Other Reconstruction, Maintenance, Repair or Alteration

☐

7. Demolition

☐

8. Building Service Contract

8. OCCUPATION FOR PROJECT :

☐ Construction (Building, Heavy  
Highway/Sewer/Water)

☐ Tunnel

☐ Residential

☐ Landscape Maintenance

☐ Elevator maintenance

☐ Exterminators, Fumigators

☐ Fire Safety Director, NYC Only

☐ Fuel Delivery

☐ Guards, Watchmen

☐ Janitors, Porters, Cleaners,  
Elevator Operators

☐ Moving furniture and  
equipment

☐ Trash and refuse removal

☐ Window cleaners

☐ Other (Describe)

9. Does this project comply with the Wicks Law involving separate bidding? YES ☐ NO ☐

10. Name and Title of Requester

**Signature**





NEW YORK STATE DEPARTMENT OF LABOR  
Bureau of Public Work - Debarment List

**LIST OF EMPLOYERS INELIGIBLE TO BID ON OR BE  
AWARDED ANY PUBLIC WORK CONTRACT**

Under Article 8 and Article 9 of the NYS Labor Law, a contractor, sub-contractor and/or its successor shall be debarred and ineligible to submit a bid on or be awarded any public work or public building service contract/sub-contract with the state, any municipal corporation or public body for a period of five (5) years from the date of debarment when:

- Two (2) final determinations have been rendered within any consecutive six-year (6) period determining that such contractor, sub-contractor and/or its successor has WILLFULLY failed to pay the prevailing wage and/or supplements;
- One (1) final determination involves falsification of payroll records or the kickback of wages and/or supplements.

The agency issuing the determination and providing the information, is denoted under the heading 'Fiscal Officer'. DOL = New York State Department of Labor; NYC = New York City Comptroller's Office; AG = New York State Attorney General's Office; DA = County District Attorney's Office.

**Debarment Database:** To search for contractors, sub-contractors and/or their successors debarred from bidding or being awarded any public work contract or subcontract under NYS Labor Law Articles 8 and 9, or under NYS Workers' Compensation Law Section 141-b, access the database at this link: <https://apps.labor.ny.gov/EDList/searchPage.do>

**For inquiries please call 518-457-5589.**



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AGENCY	Fiscal Officer	FEIN	EMPLOYER NAME	EMPLOYER DBA NAME	ADDRESS	DEBARMENT START DATE	DEBARMENT END DATE
DOL	DOL	*****5754	0369 CONTRACTORS, LLC		515 WEST AVE UNIT PH 13NORWALK CT 06850	05/12/2021	05/12/2026
DOL	DOL	*****5784	A.J.M. TRUCKING, INC.		PO BOX 2064 MONROE NY 10950	02/12/2024	02/12/2029
DOL	NYC		ALL COUNTY SEWER & DRAIN, INC.		7 GREENFIELD DR WARWICK NY 10990	03/25/2022	03/25/2027
DOL	DOL	*****8387	AMERICAN PAVING & MASONRY, CORP.		8 FOREST AVE GLEN COVE NY 11542	05/24/2024	05/24/2029
DOL	DOL	*****8654	AMERICAN PAVING, INC.		8 FORREST AVE. GLEN COVE NY 11542	05/24/2024	05/24/2029
DOL	NYC		AMJED PARVEZ		401 HANOVER AVENUE STATEN ISLAND NY 10304	01/11/2021	01/11/2026
DOL	DOL		ANGELO F COKER		2610 SOUTH SALINA STREET SUITE 14SYRACUSE NY 13205	09/17/2020	09/17/2025
DOL	DOL		ANGELO GARCIA		515 WEST AVE UNIT PH 13NORWALK CT 06850	05/12/2021	05/12/2026
DOL	DOL		ANGELO STANCO		8 FOREST AVE. GLEN COVE NY 11542	05/24/2024	05/24/2029
DOL	DOL		ANGELO TONDO		449 WEST MOMBSHA ROAD MONROE NY 10950	06/06/2022	06/06/2027
DOL	DOL	*****4231	ANKER'S ELECTRIC SERVICE, INC.		10 SOUTH 5TH ST LOCUST VALLEY NY 11560	09/26/2022	09/26/2027
DOL	DOL		ANTHONY MONGELLI		PO BOX 2064 MONROE NY 10950	02/12/2024	02/12/2029
DOL	NYC		ARADCO CONSTRUCTION CORP		115-46 132RD ST SOUTH OZONE PARK NY 11420	09/17/2020	09/17/2025
DOL	DOL		ARNOLD A. PAOLINI		1250 BROADWAY ST BUFFALO NY 14212	02/03/2020	02/03/2025
DOL	NYC		ARSHAD MEHMOOD		168-42 88TH AVENUE JAMAICA NY 11432	11/20/2019	11/20/2024
DOL	NYC		AVM CONSTRUCTION CORP		117-72 123RD ST SOUTH OZONE PARK NY 11420	09/17/2020	09/17/2025
DOL	NYC		AZIDABEGUM		524 MCDONALD AVENUE BROOKLYN NY 11218	09/17/2020	09/17/2025
DOL	DOL	*****8421	B & B DRYWALL, INC		206 WARREN AVE APT 1WHITE PLAINS NY 10603	12/14/2021	12/14/2026
DOL	DOL		B&L RENOVATION CO.		618 OCEAN PARKWAY APT A6BROOKLYN NY 11230	09/17/2020	09/17/2025
DOL	DOL		BERNARD BEGLEY		38 LONG RIDGE ROAD BEDFORD NY 10506	12/18/2019	12/18/2024
DOL	NYC	*****2113	BHW CONTRACTING, INC.		401 HANOVER AVENUE STATEN ISLAND NY 10304	01/11/2021	01/11/2026
DOL	DOL	*****3627	BJB CONSTRUCTION CORP.		38 LONG RIDGE ROAD BEDFORD NY 10506	12/18/2019	12/18/2024
DOL	DOL	*****5078	BLACK RIVER TREE REMOVAL, LLC		29807 ANDREWS ROAD BLACK RIVER NY 13032	10/17/2023	10/17/2028
DOL	DOL		BRADLEY J SCHUKA		4 BROTHERS ROAD WAPPINGERS FALLS NY 12590	10/20/2020	10/20/2025
DOL	DOL	*****9383	C.C. PAVING AND EXCAVATING, INC.		2610 SOUTH SALINA ST SUITE 12SYRACUSE NY 13205	09/17/2020	09/17/2025
DOL	DOL	*****4083	C.P.D. ENTERPRISES, INC		P.O BOX 281 WALDEN NY 12586	03/03/2020	03/03/2025
DOL	DOL	*****5161	CALADRI DEVELOPMENT CORP.		1223 PARK ST. PEEKSKILL NY 10566	05/17/2021	05/17/2026
DOL	DOL	*****3391	CALI ENTERPRISES, INC.		1223 PARK STREET PEEKSKILL NY 10566	05/17/2021	05/17/2026
DOL	DOL	*****4155	CASA BUILDERS, INC.	FRIEDLANDER CONSTRUCTI ON	64 N PUTT CONNERS ROAD NEW PALTZ NY 12561	05/10/2023	05/10/2028
DOL	AG	*****7247	CENTURY CONCRETE CORP		2375 RAYNOR ST RONKONKOMA NY 11779	08/04/2021	08/04/2026
DOL	DOL	*****0026	CHANTICLEER CONSTRUCTION LLC		4 BROTHERS ROAD WAPPINGERS FALLS NY 12590	10/20/2020	10/20/2025
DOL	NYC	*****2117	CHARAN ELECTRICAL ENTERPRISES		9-11 40TH AVENUE LONG ISLAND CITY NY 11101	09/26/2023	09/26/2028
DOL	NYC		CHARLES ZAHRADKA		863 WASHINGTON STREET FRANKLIN SQUARE NY 11010	03/10/2020	03/10/2025
DOL	DOL		CHRISTOPHER GRECO		26 NORTH MYRTLE AVENUE SPRING VALLEY NY 10956	02/18/2021	02/18/2026

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DOL	DOL		CRAIG JOHANSEN		10 SOUTH 5TH ST LOCUST VALLEY NY 11560	09/26/2022	09/26/2027
DOL	DOL	*****3228	CROSS-COUNTY LANDSCAPING AND TREE SERVICE, INC.	ROCKLAND TREE SERVICE	26 NORTH MYRTLE AVENUE SPRING VALLEY NY 10956	02/18/2021	02/18/2026
DOL	DOL	*****7619	DANCO CONSTRUCTION UNLIMITED INC.		485 RAFT AVENUE HOLBROOK NY 11741	10/19/2021	10/19/2026
DOL	DOL		DANIEL ROBERT MCNALLY		7 GREENFIELD DRIVE WARWICK NY 10990	03/25/2022	03/25/2027
DOL	DOL		DARIAN L COKER		2610 SOUTH SALINA ST SUITE 2CSYRACUSE NY 13205	09/17/2020	09/17/2025
DOL	DOL		DAVID FRIEDLANDER		64 NORTH PUTT CORNERS RD NEW PALTZ NY 12561	05/10/2023	05/10/2028
DOL	NYC		DAVID WEINER		14 NEW DROP LANE 2ND FLOORSTATEN ISLAND NY 10306	11/14/2019	11/14/2024
DOL	DOL		DINA TAYLOR		64 N PUTT CONNERS RD NEW PALTZ NY 12561	05/10/2023	05/10/2028
DOL	DOL	*****5175	EAGLE MECHANICAL AND GENERAL CONSTRUCTION LLC		11371 RIDGE RD WOLCOTT NY 14590	02/03/2020	02/03/2025
DOL	AG		EDWIN HUTZLER		23 NORTH HOWELLS RD BELLPORT NY 11713	08/04/2021	08/04/2026
DOL	DA		EDWIN HUTZLER		2375 RAYNOR STREET RONKONKOMA NY 11779	08/04/2021	08/04/2026
DOL	DOL	*****0780	EMES HEATING & PLUMBING CONTR		5 EMES LANE MONSEY NY 10952	01/20/2002	01/20/3002
DOL	DOL		EMIL KISZKO		84 DIAMOND ST BROOKLYN NY 11222	07/18/2024	07/18/2029
DOL	DOL	*****3298	EMJACK CONSTRUCTION CORP.		84 DIAMOND ST BROOKLYN NY 11222	07/18/2024	07/18/2029
DOL	DOL	*****3298	EMJACK CONSTRUCTION LLC		4192 SIR ANDREW CIRCLE DOYLESTOWN PA 18902	07/18/2024	07/18/2029
DOL	DOL		EUGENIUSZ "GINO" KUCHAR		195 KINGSLAND AVE BROOKLYN NY 11222	12/22/2023	12/22/2028
DOL	DA		FREDERICK HUTZLER		2375 RAYNOR STREET RONKONKOMA NY 11779	08/04/2021	08/04/2026
DOL	NYC	*****6616	G & G MECHANICAL ENTERPRISES, LLC.		1936 HEMPSTEAD TURNPIKE EAST MEDOW NY 11554	11/29/2019	11/29/2024
DOL	DOL	*****2998	G.E.M. AMERICAN CONSTRUCTION CORP.		195 KINGSLAND AVE BROOKLYN NY 11222	12/22/2023	12/22/2028
DOL	NYC		GAYATRI MANGRU		21 DAREWOOD LANE VALLEY STREAM NY 11581	09/17/2020	09/17/2025
DOL	DA		GEORGE LUCEY		150 KINGS STREET BROOKLYN NY 11231	01/19/1998	01/19/2998
DOL	DA		GIOVANNA TRAVALJA		3735 9TH ST LONG ISLAND CITY NY 11101	01/05/2023	01/05/2028
DOL	DA		GIOVANNI NAPOLITANO		2501 BAYVIEW AVENUE WANTAGH NY 11793	02/21/2024	02/21/2029
DOL	DA	*****0213	GORILLA CONTRACTING GROUP, LLC		505 MANHATTAN AVE WEST BABYLON NY 11704	10/05/2023	10/05/2028
DOL	DA	*****4760	GTX CONSTRUCTION ASSOCIATES, CORP		2501 BAYVIEW AVE WANTAGH NY 11793	02/21/2024	02/21/2029
DOL	DOL		HANS RATH		24 ELDOR AVENUE NEW CITY NY 10956	02/03/2020	02/03/2025
DOL	DOL		HERBERT CLEMEN		42 FOWLER AVENUE CORTLAND MANOR NY 10567	01/24/2023	01/24/2028
DOL	DOL		HERBERT CLEMEN		42 FOWLER AVENUE CORTLAND MANOR NY 10567	10/25/2022	10/25/2027
DOL	DOL	*****9211	J. WASE CONSTRUCTION CORP.		8545 RT 9W ATHENS NY 12015	03/09/2021	03/09/2026
DOL	DOL		J.M.J CONSTRUCTION		151 OSTRANDER AVENUE SYRACUSE NY 13205	11/21/2022	11/21/2027
DOL	DOL		J.R. NELSON CONSTRUCTION		531 THIRD STREET ALBANY NY 12206	11/07/2023	11/07/2028
DOL	DOL		J.R. NELSON CONSTRUCTION		531 THIRD STREET ALBANY NY 12206	12/22/2022	12/22/2027
DOL	DOL		J.R. NELSON CONSTRUCTION		531 THIRD STREET ALBANY NY 12206	10/25/2022	10/25/2027
DOL	DOL		J.R. NELSON, LLC		531 THIRD STREET ALBANY NY 12206	12/22/2022	12/22/2027
DOL	DOL		J.R. NELSON, LLC		531 THIRD STREET ALBANY NY 12206	11/07/2023	11/07/2028
DOL	DOL		J.R. NELSON, LLC		531 THIRD STREET ALBANY NY 12206	10/25/2022	10/25/2027

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DOL	DOL		J.R.N COMPANIES, LLC		531 THIRD STREET ALBANY NY 12206	12/12/2022	12/12/2027
DOL	DOL		J.R.N COMPANIES, LLC		531 THIRD STREET ALBANY NY 12206	11/07/2023	11/07/2028
DOL	DOL		J.R.N COMPANIES, LLC		531 THIRD STREET ALBANY NY 12206	10/25/2022	10/25/2027
DOL	DOL	*****1147	J.R.N. CONSTRUCTION, LLC		531 THIRD ST ALBANY NY 12206	11/07/2023	11/07/2028
DOL	DOL	*****1147	J.R.N. CONSTRUCTION, LLC		531 THIRD ST ALBANY NY 12206	12/22/2022	12/22/2027
DOL	DOL	*****1147	J.R.N. CONSTRUCTION, LLC		531 THIRD ST ALBANY NY 12206	10/25/2022	10/25/2027
DOL	DOL		JAMES J. BAKER		7901 GEE ROAD CANASTOTA NY 13032	08/17/2021	08/17/2026
DOL	DOL		JASON P. RACE		3469 STATE RT. 69 PERISH NY 13131	09/29/2021	09/29/2026
DOL	DOL		JASON P. RACE		3469 STATE RT. 69 PERISH NY 13131	02/09/2022	02/09/2027
DOL	DOL		JASON P. RACE		3469 STATE RT. 69 PERISH NY 13131	11/15/2022	11/15/2027
DOL	DOL		JASON P. RACE		3469 STATE RT. 69 PERISH NY 13131	03/01/2022	03/01/2027
DOL	DOL	*****7993	JBS DIRT, INC.		7901 GEE ROAD CANASTOTA NY 13032	08/17/2021	08/17/2026
DOL	DOL	*****2435	JEFFEL D. JOHNSON	JMJ7 AND SON	5553 CAIRNSTRAIL CLAY NY 13041	11/21/2022	11/21/2027
DOL	DOL		JEFFEL JOHNSON ELITE CARPENTER REMODEL AND CONSTRUCTION		C2 EVERGREEN CIRCLE LIVERPOOL NY 13090	11/21/2022	11/21/2027
DOL	DOL	*****2435	JEFFREY M. JOHNSON	JMJ7 AND SON	5553 CAIRNS TRAIL CLAY NY 13041	11/21/2022	11/21/2027
DOL	NYC		JENNIFER GUERRERO		1936 HEMPSTEAD TURNPIKE EAST MEADOW NY 11554	11/29/2019	11/29/2024
DOL	DOL		JIM PLAUGHER		17613 SANTE FE LINE ROAD WAYNEFIELD OH 45896	07/16/2021	07/16/2026
DOL	DOL		JMJ7 & SON CONSTRUCTION, LLC		5553 CAIRNS TRAIL LIVERPOOL NY 13041	11/21/2022	11/21/2027
DOL	DOL		JMJ7 AND SONS CONTRACTORS		5553 CAIRNS TRAIL CLAY NY 13041	11/21/2022	11/21/2027
DOL	DOL		JMJ7 CONTRACTORS		7014 13TH AVENUE BROOKLYN NY 11228	11/21/2022	11/21/2027
DOL	DOL		JMJ7 CONTRACTORS AND SONS		5553 CAIRNS TRAIL CLAY NY 13041	11/21/2022	11/21/2027
DOL	DOL		JMJ7 CONTRACTORS, LLC		5553 CAIRNS TRAIL CLAY NY 13041	11/21/2022	11/21/2027
DOL	DOL		JOHN GOCEK		14B COMMERCIAL AVE ALBANY NY 12065	11/14/2019	11/14/2024
DOL	DOL		JOHN MARKOVIC		47 MANDON TERRACE HAWTHORN NJ 07506	03/29/2021	03/29/2026
DOL	DOL		JOHN WASE		8545 RT 9W ATHENS NY 12015	03/09/2021	03/09/2026
DOL	DOL		JORGE RAMOS		8970 MIKE GARCIA DR MANASSAS VA 20109	07/16/2021	07/16/2026
DOL	DOL		JOSEPH K. SALERNO		1010 TILDEN AVE UTICA NY 13501	07/24/2023	07/24/2028
DOL	DOL		JOSEPH K. SALERNO II		1010 TILDEN AVE UTICA NY 13501	07/24/2023	07/24/2028
DOL	DOL	*****5116	JP RACE PAINTING, INC. T/A RACE PAINTING		3469 STATE RT. 69 PERISH NY 13131	02/09/2022	02/09/2027
DOL	DOL	*****5116	JP RACE PAINTING, INC. T/A RACE PAINTING		3469 STATE RT. 69 PERISH NY 13131	11/15/2022	11/15/2027
DOL	DOL	*****5116	JP RACE PAINTING, INC. T/A RACE PAINTING		3469 STATE RT. 69 PERISH NY 13131	09/29/2021	09/29/2026
DOL	DOL	*****5116	JP RACE PAINTING, INC. T/A RACE PAINTING		3469 STATE RT. 69 PERISH NY 13131	03/01/2022	03/01/2027
DOL	DOL	*****5116	JP RACE PAINTING, INC. T/A RACE PAINTING		3469 STATE RT. 69 PERISH NY 13131	03/01/2022	03/01/2027
DOL	DOL		JRN CONSTRUCTION CO, LLC		1024 BROADWAY ALBANY NY 12204	11/07/2023	11/07/2028
DOL	DOL	*****1147	JRN CONSTRUCTION, LLC		531 THIRD STREET ALBANY NY 12206	10/25/2022	10/25/2027
DOL	DOL	*****1147	JRN CONSTRUCTION, LLC		531 THIRD STREET ALBANY NY 12206	12/22/2022	12/22/2027
DOL	DOL	*****1147	JRN CONSTRUCTION, LLC		531 THIRD STREET ALBANY NY 12206	11/07/2023	11/07/2028

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DOL	DOL		JRN PAVING, LLC		531 THIRD STREET ALBANY NY 12206	10/25/2022	10/25/2027
DOL	DOL		JRN PAVING, LLC		531 THIRD STREET ALBANY NY 12206	12/22/2022	12/22/2027
DOL	DOL		JRN PAVING, LLC		531 THIRD STREET ALBANY NY 12206	11/07/2023	11/07/2028
DOL	DOL		JULIUS AND GITA BEHREND		5 EMES LANE MONSEY NY 10952	11/20/2002	11/20/3002
DOL	DOL		KARIN MANGIN		796 PHELPS ROAD FRANKLIN LAKES NJ 07417	12/01/2020	12/01/2025
DOL	DOL		KATE E. CONNOR		7088 INTERSTATE ISLAND RD SYRACUSE NY 13209	03/31/2021	03/31/2026
DOL	DOL		KEAN INDUSTRIES, LLC		2345 RT. 52 SUITE 2NHOPEWELL JUNCTION NY 12533	12/18/2023	12/18/2028
DOL	DOL	*****2959	KELC DEVELOPMENT, INC		7088 INTERSTATE ISLAND RD SYRACUSE NY 13209	03/31/2021	03/31/2026
DOL	DOL		KIMBERLY F. BAKER		7901 GEE ROAD CANASTOTA NY 13032	08/17/2021	08/17/2026
DOL	DOL		KMA GROUP II, INC.		29-10 38TH AVENUE LONG ISLAND CITY NY 11101	10/11/2023	10/11/2028
DOL	DOL	*****1833	KMA GROUP INC.		29-10 38TH AVENUE LONG ISLAND CITY NY 11101	10/11/2023	10/11/2028
DOL	DOL		KMA INSULATION, INC.		29-10 38TH AVENUE LONG ISLAND CITY NY 11101	10/11/2023	10/11/2028
DOL	DOL		KRIN HEINEMANN		2345 ROUTE 52, SUITE 2N HOPEWELL JUNCTION NY 12533	12/18/2023	12/18/2028
DOL	NYC		KULWANT S. DEOL		9-11 40TH AVENUE LONG ISLAND CITY NY 11101	09/26/2023	09/26/2028
DOL	DA	*****8816	LAKE CONSTRUCTION AND DEVELOPMENT CORPORATION		150 KINGS STREET BROOKLYN NY 11231	08/19/1998	08/19/2998
DOL	DOL		LEROY E. NELSON JR		531 THIRD ST ALBANY NY 12206	10/25/2022	10/25/2027
DOL	DOL		LEROY E. NELSON JR		531 THIRD ST ALBANY NY 12206	12/22/2022	12/22/2027
DOL	DOL		LEROY E. NELSON JR		531 THIRD ST ALBANY NY 12206	11/07/2023	11/07/2028
DOL	AG	*****3291	LINTECH ELECTRIC, INC.		3006 TILDEN AVE BROOKLYN NY 11226	02/16/2022	02/16/2027
DOL	DOL		LOUIS A. CALICCHIA		1223 PARK ST. PEEKSKILL NY 10566	05/17/2021	05/17/2026
DOL	NYC		LUBOMIR PETER SVOBODA		27 HOUSMAN AVE STATEN ISLAND NY 10303	12/26/2019	12/26/2024
DOL	NYC		M & L STEEL & ORNAMENTAL IRON CORP.		27 HOUSMAN AVE STATEN ISLAND NY 10303	12/26/2019	12/26/2024
DOL	DOL	*****2196	MAINSTREAM SPECIALTIES, INC.		11 OLD TOWN RD SELKIRK NY 12158	02/02/2021	02/02/2026
DOL	DA		MANUEL P TOBIO		150 KINGS STREET BROOKLYN NY 14444	08/19/1998	08/19/2998
DOL	DA		MANUEL TOBIO		150 KINGS STREET BROOKLYN NY 11231	08/19/1998	08/19/2998
DOL	DOL		MAQSOOD AHMAD		618 OCEAN PKWY BROOKLYN NY 11230	09/17/2020	09/17/2025
DOL	NYC		MARIA NUBILE		84-22 GRAND AVENUE ELMHURST NY 11373	03/10/2020	03/10/2025
DOL	NYC	*****9926	MILLENNIUM FIRE PROTECTION, LLC		325 W. 38TH STREET SUITE 204NEW YORK NY 10018	11/14/2019	11/14/2024
DOL	NYC	*****0627	MILLENNIUM FIRE SERVICES, LLC		14 NEW DROP LNE 2ND FLOORSTATEN ISLAND NY 10306	11/14/2019	11/14/2024
DOL	DOL	*****1320	MJC MASON CONTRACTING, INC.		42 FOWLER AVENUE CORTLAND MANOR NY 10567	10/25/2022	10/25/2027
DOL	DOL	*****1320	MJC MASON CONTRACTING, INC.		42 FOWLER AVENUE CORTLAND MANOR NY 10567	01/24/2023	01/24/2028
DOL	NYC		MUHAMMED A. HASHEM		524 MCDONALD AVENUE BROOKLYN NY 11218	09/17/2020	09/17/2025
DOL	NYC		NAMOW, INC.		84-22 GRAND AVENUE ELMHURST NY 11373	03/10/2020	03/10/2025
DOL	DOL	*****7790	NATIONAL BUILDING & RESTORATION CORP		1010 TILDEN AVE UTICA NY 13501	07/24/2023	07/24/2028
DOL	DOL	*****1797	NATIONAL CONSTRUCTION SERVICES, INC		1010 TILDEN AVE UTICA NY 13501	07/24/2023	07/24/2028



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DOL	NYC		NAVIT SINGH		402 JERICHO TURNPIKE NEW HYDE PARK NY 11040	08/10/2022	08/10/2027
DOL	DOL		NELCO CONTRACTING, LLC		1024 BROADWAY ALBANY NY 12204	11/07/2023	11/07/2028
DOL	DA		NICHOLAS T. ANALITIS		505 MANHATTAN AVE WEST BABYLON NY 11704	10/05/2023	10/05/2028
DOL	DOL		NICHOLE E. FRASER A/K/A NICHOLE RACE		3469 STATE RT. 69 PERISH NY 13131	03/01/2022	03/01/2027
DOL	DOL		NICHOLE E. FRASER A/K/A NICHOLE RACE		3469 STATE RT. 69 PERISH NY 13131	11/15/2022	11/15/2027
DOL	DOL		NICHOLE E. FRASER A/K/A NICHOLE RACE		3469 STATE RT. 69 PERISH NY 13131	09/29/2021	09/29/2026
DOL	DOL		NICHOLE E. FRASER A/K/A NICHOLE RACE		3469 STATE RT. 69 PERISH NY 13131	02/09/2022	02/09/2027
DOL	DOL	*****7429	NICOLAE I. BARBIR	BESTUCCO CONSTRUCTI ON, INC.	444 SCHANTZ ROAD ALLENTOWN PA 18104	09/17/2020	09/17/2025
DOL	NYC	*****5643	NYC LINE CONTRACTORS, INC.		402 JERICHO TURNPIKE NEW HYDE PARK NY 11040	08/10/2022	08/10/2027
DOL	DOL		PATRICK PENNACCHIO		2345 RT. 52 SUITE 2NHOPEWELL JUNCTION NY 12533	12/18/2023	12/18/2028
DOL	DOL		PATRICK PENNACCHIO		2345 RT. 52 SUITE 2NHOPEWELL JUNCTION NY 12533	12/18/2023	12/18/2028
DOL	DOL		PAULINE CHAHALES		935 S LAKE BLVD MAHOPAC NY 10541	03/02/2021	03/02/2026
DOL	DOL		PETER STEVENS		11 OLD TOWN ROAD SELKIRK NY 12158	02/02/2021	02/02/2026
DOL	DOL		PETER STEVENS		8269 21ST ST BELLEROSSE NY 11426	12/22/2022	12/22/2027
DOL	DOL	*****4168	PHANTOM CONSTRUCTION CORP.		95-27 116TH STREET QUEENS NY 11419	07/12/2024	07/12/2029
DOL	DOL	*****4168	PHANTOM CONSTRUCTION CORP.		95-27 116TH STREET QUEENS NY 11419	05/28/2024	05/28/2029
DOL	DOL	*****0466	PRECISION BUILT FENCES, INC.		1617 MAIN ST PEEKSKILL NY 10566	03/03/2020	03/03/2025
DOL	NYC		RASHEL CONSTRUCTION CORP		524 MCDONALD AVENUE BROOKLYN NY 11218	09/17/2020	09/17/2025
DOL	DOL	*****1068	RATH MECHANICAL CONTRACTORS, INC.		24 ELDOR AVENUE NEW CITY NY 10956	02/03/2020	02/03/2025
DOL	DOL	*****2633	RAW POWER ELECTRIC CORP.		3 PARK CIRCLE MIDDLETOWN NY 10940	07/11/2022	07/11/2027
DOL	DA	*****7559	REGAL CONTRACTING INC.		24 WOODBINE AVE NORTHPORT NY 11768	10/01/2020	10/01/2025
DOL	DOL		RICHARD REGGIO		1617 MAIN ST PEEKSKILL NY 10566	03/03/2020	03/03/2025
DOL	DOL		ROBBYE BISSEAR		89-51 SPRINGFIELD BLVD QUEENS VILLAGE NY 11427	01/11/2003	01/11/3003
DOL	DOL		ROMEO WARREN		161 ROBYN RD MONROE NY 10950	07/11/2022	07/11/2027
DOL	DOL		RONALD MESSEN		14B COMMERCIAL AVE ALBANY NY 12065	11/14/2019	11/14/2024
DOL	DOL	*****7172	RZ & AL INC.		198 RIDGE AVENUE VALLEY STREAM NY 11581	06/06/2022	06/06/2027
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DOL	DA	*****0476	SAMCO ELECTRIC CORP.		3735 9TH ST LONG ISLAND CITY NY 11101	01/05/2023	01/05/2028
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DOL	DOL	*****2045	SCOTT DUFFIE	DUFFIE'S ELECTRIC, INC.	P.O BOX 111 CORNWALL NY 12518	03/03/2020	03/03/2025
DOL	DOL		SCOTT DUFFIE		P.O BOX 111 CORNWALL NY 12518	03/03/2020	03/03/2025
DOL	DA		SILVANO TRAVAJA		3735 9TH ST LONG ISLAND CITY NY 11101	01/05/2023	01/05/2028
DOL	DOL	*****0440	SOLAR GUYS INC.		8970 MIKE GARCIA DR MANASSAS VA 20109	07/16/2021	07/16/2026
DOL	NYC		SOMATIE RAMSUNAHAI		115-46 132ND ST SOUTH OZONE PARK NY 11420	09/17/2020	09/17/2025
DOL	DOL	*****2221	SOUTH BUFFALO ELECTRIC, INC.		1250 BROADWAY ST BUFFALO NY 14212	02/03/2020	02/03/2025
DOL	NYC	*****3661	SPANIER BUILDING MAINTENANCE CORP		200 OAK DRIVE SYOSSET NY 11791	03/14/2022	03/14/2027
DOL	DOL		STANADOS KALOGELAS		485 RAFT AVENUE HOLBROOK NY 11741	10/19/2021	10/19/2026
DOL	DOL	*****3496	STAR INTERNATIONAL INC		89-51 SPRINGFIELD BLVD QUEENS VILLAGE NY 11427	08/11/2003	08/11/3003
DOL	DOL	*****6844	STEAM PLANT AND CHX SYSTEMS INC.		14B COMMERCIAL AVENUE ALBANY NY 12065	11/14/2019	11/14/2024
DOL	DOL	*****9528	STEEL-IT, LLC.		17613 SANTE FE LINE ROAD WAYNESFIELD OH 45896	07/16/2021	07/16/2026
DOL	DOL	*****3800	SUBURBAN RESTORATION CO. INC.		5-10 BANTA PLACE FAIR LAWN PLACE NJ 07410	03/29/2021	03/29/2026
DOL	DOL	*****9150	SURGE INC.		8269 21ST STREET BELLEROSE NY 11426	12/22/2022	12/22/2027
DOL	DOL		SYED RAZA		198 RIDGE AVENUE NY 11581	06/06/2022	06/06/2027
DOL	DOL		TARLOK SINGH		95-27 116TH STREET QUEENS NY 11419	05/28/2024	05/28/2029
DOL	DOL		TARLOK SINGH		95-27 116TH STREET QUEENS NY 11419	07/12/2024	07/12/2029
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DOL	DOL	*****5766	THE COKER CORPORATION	COKER CORPORATION	2610 SOUTH SALINA ST SUITE 14SYRACUSE NY 13205	09/17/2020	09/17/2025
DOL	DOL		TIMOTHY PERCY		29807 ANDREWS ROAD BLACK RIVER NY 13612	10/17/2023	10/17/2028
DOL	DA	*****1050	TRI STATE CONSTRUCTION OF NY CORP.		50-39 175TH PLACE FRESH MEADOWS NY 11365	03/28/2022	03/28/2027
DOL	DA	*****4106	TRIPLE H CONCRETE CORP		2375 RAYNOR STREET RONKONKOMA NY 11779	08/04/2021	08/04/2026
DOL	DOL	*****8210	UPSTATE CONCRETE & MASONRY CONTRACTING CO INC		449 WEST MOMBSHA ROAD MONROE NY 10950	06/06/2022	06/06/2027
DOL	DOL	*****6418	VALHALLA CONSTRUCTION, LLC.		796 PHLEPS ROAD FRANKLIN LAKES NJ 07417	12/01/2020	12/01/2025
DOL	NYC	*****2426	VICKRAM MANGRU	VICK CONSTRUCTION	21 DAREWOOD LANE VALLEY STREAM NY 11581	09/17/2020	09/17/2025
DOL	NYC		VICKRAM MANGRU		21 DAREWOOD LANE VALLEY STREAM NY 11581	09/17/2020	09/17/2025
DOL	DOL		VIKTORIA RATH		24 ELDOR AVENUE NEW CITY NY 10956	02/03/2020	02/03/2025
DOL	DOL	*****8266	WILLIAM CHRIS MCCLENDON	MCCLENDON ASPHALT PAVING	1646 FALLS STREET NIAGARA FALLS NY 14303	05/01/2023	05/01/2028
DOL	DOL		WILLIAM CHRIS MCCLENDON		1646 FALLS STREET NIAGARA FALLS NY 14303	05/01/2023	05/01/2028
DOL	DOL		WILLIAM G. PROERFRIEDT		85 SPRUCEWOOD ROAD WEST BABYLON NY 11704	01/19/2021	01/19/2026
DOL	DOL	*****5924	WILLIAM G. PROPHY, LLC	WGP CONTRACTING, INC.	54 PENTAQUIT AVE BAYSHORE NY 11706	01/19/2021	01/19/2026
DOL	DOL		WILLIAM SCRIVENS		4192 SIR ANDREW CIRCLE DOYELSTOWN PA 18902	07/18/2024	07/18/2029

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STATE OF NEW YORK - EXECUTIVE DEPARTMENT  
OFFICE OF GENERAL SERVICES - DESIGN & CONSTRUCTION GROUP

DOCUMENT 000001  
GENERAL CONDITIONS  
AUGUST 2010 EDITION

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## GENERAL CONDITIONS – AUGUST 2010

### ARTICLE 1 - THE CONTRACT DOCUMENTS

1.1 The Contract Documents consist of the Agreement, the Performance and Payment Bonds, the General Conditions, the Supplementary Conditions, Appendix A, the Drawings and Specifications, Addenda issued prior to the receipt of bids and all subsequent modifications and changes issued pursuant to the General Conditions.

1.1.1 The Performance and Payment Bonds are not a part of Single Trade Contract less than two hundred thousand dollars.

1.2 The Contract Documents form the Contract. The Contract represents the entire and integrated agreement between the parties and supersedes all prior negotiations, representations and agreements, either written or oral including the bidding documents.

1.3 The Contract may not be modified except in accordance with the General Conditions.

1.4 The project is designed in accordance with the Building Codes of New York State and its reference standards. In no instance shall the Contractor deviate from the contract documents except as provided for in the contract. The Contractor shall notify the State of any deviations or conflicts observed that may violate the Building Codes.

### ARTICLE 2 - DEFINITIONS

2.1 The following terms shall have the meanings ascribed to them in this Article, wherever they appear in the Contract Documents.

2.2 The term "Agency" means the officer, board, department, commission, authority, fund or public benefit corporation executing the Agreement.

2.3 The term "Commissioner" means the Commissioner of General Services.

2.4 The term "Comptroller" means the Comptroller of the State of New York.

2.5 The term "Contracting Officer" means the Director of Contract Administration of the Design and Construction Group of the Office of General Services or his representative designated in writing.

2.6 The term "Contractor" means the person, firm or corporation executing the Agreement or the successor or assignee of the Contractor approved in writing by the Contracting Officer. If the text requires, the term includes the person, firm or corporation executing any Agreement in furtherance of the Project or the successors

or assigns approved in writing by the Contracting Officer.

2.7 The term "days" means calendar days.

2.8 The term "Director" means the Director of Construction of the Design and Construction Group of the Office of General Services who will have general direction and supervision of the Work.

2.9 The term "Director's Representative" means the employee or agent of the Design and Construction Group designated in writing by the Director as such. Under the general supervision of the Director, the Director's Representative shall have complete charge of the Work and shall exercise full supervision and direction of the Work. Where the Contract Documents specifically designate a person to perform a function or duty, that person shall be the Director's Representative but only for the performance of that function or duty. Where the word "directed" appears in the Contract Documents, the words "by the Director's Representative" shall be deemed inserted thereafter in each case except where it is obviously inappropriate in context.

2.10 The term "Group Director" means the Deputy Commissioner for Design and Construction, Office of General Services.

2.11 The term "liquidated damages" means the amount of money to be assessed against the Contractor for delay in physical completion of the Work.

2.12 The term "physical completion" means the date upon which the Director's Representative certifies that all deficiencies noted on the Final Inspection List have been corrected and is evidenced by issuance of the Physical Completion Report.

2.13 The term "premises" means all land, buildings, structures and all other things of any kind located on or adjacent to the Site and owned, occupied or otherwise used by the State.

2.14 The term "product data" means manufacturer's catalog sheets, brochures, standard diagrams, illustrations, schedules, performance charts, test data, standard schematic drawings, specifications and installation instructions.

2.15 The term "Project" means Work at the same Site carried out pursuant to one or more sets of Contract Documents.

2.16 The term "provide" means furnish and install complete, in place and ready for operation and use.

2.17 The term “sample” means physical examples submitted by the Contractor of materials, equipment or workmanship to establish a standard which the Contractor is required to meet and to show the quality, type, range of color, finish, and texture of the material intended to be furnished for the Work.

2.18 The term “shop drawing” means an original drawing prepared by a Contractor, subcontractor, supplier or distributor which illustrates some portion of the Work showing fabrication, layout, fitting or erection details.

2.19 The term “Site” means the area within the contract limit, as indicated by the Contract Documents, including all land, buildings, structures and other things located within those limits.

2.20 The term “State” means the State of New York.

2.21 The term “substantial completion” means that the Work or major milestones there of as contemplated by the terms of this contract are sufficiently complete so that the Work can be used for the purpose for which it is intended.

2.22 The term “Work” means all that which is required of the Contractor by the Contract Documents including labor, materials, tools and equipment.

2.23 The term “Offerer” shall mean the individual or entity, or any employee, agent, consultant or person acting on behalf of such individual or entity that contacts a governmental entity about a governmental procurement during the restricted period of such governmental procurement.

### ARTICLE 3 - INTERPRETATION OF CONTRACT DOCUMENTS

3.1 The Contract Documents are complementary, and what is called for by one shall be as binding as if called for by all. It is not intended to include work not properly inferable from the Contract Documents.

3.2 Upon the Contractor’s written request, the Director’s Representative may issue written interpretation or drawings necessary for the proper execution or progress of the Work which interpretation shall be consistent with and reasonably inferable from the Contract Documents.

3.3 The language of the Contract Documents is directed at the Contractor unless specifically stated otherwise.

3.4 The organization of the Specifications into divisions, sections and articles, and the arrangement of Drawings shall not control the Contractor in dividing the

Work among subcontractors or in establishing the extent of Work to be performed by any trade.

3.5 In the event of conflicting provisions in the Contract Documents, the drawings will take precedence over the specifications.

3.6 In the event of conflicting provisions within the drawings, the following order of precedence for resolution of the conflict shall apply: the more specific provision will take precedence over the less specific; if not resolved, the less stringent will take precedence over the more stringent; if not resolved, the less expensive item will take precedence over the more expensive. On all drawings, figures take precedence over scaled dimensions.

3.7 In the event of conflicting provisions within the specifications, the following order of precedence for resolution of the conflict shall apply: the more specific provision will take precedence over the less specific; if not resolved, the less stringent will take precedence over the more stringent; if not resolved, the less expensive item will take precedence over the more expensive.

3.8 If during the performance of the work, the Contractor identifies a conflict in the Contract Documents; the Contractor shall promptly notify the Director’s Representative in writing of the conflict and advise as to the course of action the Contractor proposes to follow. The Director’s Representative shall promptly acknowledge the notification in writing and advise the Contractor, pursuant to Paragraph 3.2 of these General Conditions, as to the interpretation to be followed in the performance of the Work.

### ARTICLE 4 - SUBMITTALS

4.1 The Contractor and the Director shall adhere to the submittal and scheduling requirements specified in Division 01 - General Requirements.

4.2 The Contractor shall approve all submittals before submitting them. By such approval, the Contractor represents that it has determined and verified field measurements, field construction criteria, materials, catalog numbers, and similar data and that it has checked and coordinated shop drawings, product data and samples with the requirements of the Contract Documents and that it has verified the completeness, correctness, and accuracy of the submittal.

4.3 The Director’s approval of shop drawings, product data and samples shall not relieve the Contractor of responsibility for any deviation from the requirements of the Contract Documents unless the Contractor has previously informed the Director of any anticipated deviation utilizing the required deviation request form, (available at the OGS D&C website), at the time of submission. Written approval of the specific deviations

as outlined on the request form shall be required. The Director's approval shall not relieve the Contractor from responsibility for errors or omissions in the shop drawings, product data or samples.

4.4 Portions of the Work requiring shop drawings, product data, quality assurance information, or sample submittals shall not be commenced until the appropriate submittals have been approved by the Director.

4.5 The Contractor shall deliver to the Director, in the detail and form and at the time the Director shall require, information concerning the Contractor's operations and proposed operations upon the Project all in accordance with Division 01 - General Requirements.

4.6 During the term of this Project, the Director may require any Contractor to modify any schedules which it has submitted either before or after they are approved so that the Work of any contract in furtherance of the Project may be properly progressed and so that changes in the Work or the work of related contracts is properly reflected in the schedules.

4.7 Where indicated under the specific submittal requirements of the specifications, a re-evaluation fee of \$250.00 will be assessed against the Contractor for each re-evaluation required of any submittal package that is deemed incomplete, or lacking appropriate content or required format as required by the individual specification section.

## ARTICLE 5 - MATERIALS AND LABOR

5.1 All materials, equipment and articles used permanently in the Work which become the property of the State shall be new unless specifically stated otherwise.

5.2 Asbestos Free Materials: All materials used for construction shall be free of asbestos containing materials unless the materials containing the asbestos have been previously approved for use by the State. If asbestos is found in installed products not previously approved by the State, then it will be the responsibility of the contractor to abate the asbestos containing material and replace the work with new asbestos free materials at no cost to the State of New York in compliance with the requirements of the contract.

5.3 Except where specifically provided otherwise, whenever any product is specified by brand name, i.e., manufacturer's or supplier's name or trade name and catalog or model number or name, the intent is not to limit competition but to establish a standard of quality which the Director has determined is necessary. The words "or equal" shall be deemed inserted in each instance. The Contractor may use any product equal to that named in the Contract Documents which is approved by the Director and which meets the requirements of the

Contract Documents providing the Contractor gives timely notice of the Contractor's intent in accordance with the submittal and scheduling requirements of Division 01 - General Requirements.

5.4 The Contractor shall have the burden of proving at the Contractor's own cost and expense, to the satisfaction of the Director, that the proposed product is equal to the named product. The Director may establish criteria for product approval. The Director shall determine with absolute discretion whether a proposed product is to be approved.

5.5 If the Contractor fails to comply with the provisions of this Article, or if the Director determines that the proposed product is not equal to that named, the Contractor shall supply the product named.

5.6 The Contractor shall have and make no claim for the extension of time or for damages because the Director requires a reasonable period of time to consider a product proposed by the Contractor or because the Director disapproves such a product.

5.7 Where optional materials or methods are specified, or where "or equal" submissions are approved, the Contractor shall make all adjustments to contingent Work, whether the contingent Work be the Work of its contract or the Work of other Contractor's, necessary to accommodate the option or "or equal" product it selects without extra or additional cost.

5.8 Royalties and Patents: The Contractor shall pay all royalties and license fees. The Contractor shall defend all suits or claims for infringement of any patent rights and shall save the State harmless from loss on account thereof, except that the State shall be responsible for all such loss when a particular design, process or the product of a particular manufacturer is specified.

## ARTICLE 6 - CONTRACTOR'S SUPERVISION

6.1 The Contractor shall designate in writing competent supervision and/or management representatives as required below to represent the Contractor at all times with authority to act for the Contractor. All Direction given to the Contractor's Representatives shall be as binding as if given to the Contractor. A Superintendent or Project Manager shall be classified as management representatives included in the Contractor's overhead and shall perform management, supervisory and/or administrative tasks (non labor) only. Individuals listed under this Article shall have the ability to effectively communicate (verbal and written) with all parties associated with the administration/supervision of this contract.

6.1.1 For contracts valued up to \$500,000 the contractor shall provide a supervisor for the Contractor's

staff who shall be in attendance at the site throughout the active performance of the Work.

6.1.2 For contracts valued from \$500,000 to \$2,000,000 the Contractor shall provide a Superintendent for the Contractor's staff who shall be in attendance at the site throughout the active performance of the Work until Substantial Completion. Upon Substantial Completion the contractor shall provide a supervisor who shall be in attendance at the site throughout the active performance of the Work until Physical Completion. The Superintendent shall have the authority to direct and schedule the Work, shall attend all project meetings, shall coordinate the Work of subcontractors, and make purchase and cost decisions on behalf of the Contractor.

6.1.3 For contracts valued from \$2,000,001 to \$5,000,000 the contractor shall provide a Superintendent for the Contractor's staff who shall be in attendance at the site throughout the active performance of the Work until Substantial Completion. Upon Substantial Completion the contractor shall provide a supervisor who shall be in attendance at the site throughout the active performance of the Work until Physical Completion. The Superintendent shall have the authority to direct the Work, attend all project meetings, and coordinate the Work of subcontractors. The Contractor shall also provide a Project Manager who shall attend project meetings, maintain submittal and approval system, and be responsible for change order/field order responses and negotiations. The Contractor shall provide required information to the Director's Representative for the Project Schedule.

6.1.4 For contracts valued from \$5,000,001 to \$10,000,000 the contractor shall provide a Project Manager and Superintendent for the Contractor's staff that shall be in attendance at the site throughout the active performance of the Work until Substantial Completion. Upon Substantial Completion the contractor shall provide a supervisor who shall be in attendance at the site throughout the active performance of the Work until Physical Completion. The Superintendent shall have the authority to direct the Work, and coordinate the Work of subcontractors. The Project Manager shall attend project meetings, maintain the project schedule, maintain submittal and approval system, and be responsible for change order/field order responses and negotiations.

6.1.5 For contracts valued for more than \$10,000,000 the contractor shall provide a Project Manager and Superintendent for the Contractor's staff who shall be in attendance at the site throughout the active performance of the Work until Substantial Completion. Upon Substantial Completion the contractor shall provide a supervisor who shall be in attendance at the site throughout the active performance of the Work until Physical Completion. The Superintendent shall have the authority to direct the

Work, attend all project meetings, and coordinate the Work of subcontractors. The Project Manager shall attend project meetings, maintain the project schedule, maintain submittal and approval system, and be responsible for change order/field order responses and negotiations. If at any time there are more than five subcontractors performing work on the site simultaneously an additional Superintendent is required coordinate their Work.

6.2 Should the Director deem any employees of the Contractor incompetent or negligent or for any cause unfit for their duty, the Contractor shall dismiss them and they shall not again be employed on the Work.

6.3 Before any part of the Contract shall be sublet or material purchased, the Contractor shall submit to the Director in writing the name of each proposed subcontractor and supplier and obtain the Director's written consent to such subcontractor and supplier. The names shall be submitted in ample time to permit acceptance or rejection of each proposed subcontractor and supplier by the Director or Contracting Officer without causing delay in the work of the Project. The Contractor shall promptly furnish such information as the Director or Contracting Officer may require concerning the proposed subcontractor's and supplier's ability and qualifications, and Minority/Women Owned Business Enterprises Status. Each request for approval of a subcontractor whose subcontract will be valued at \$10,000.00 or more shall also be accompanied by a NYS Vendor Responsibility Questionnaire - For-Profit Construction properly completed and executed by the proposed subcontractor.

6.4 The Contractor's use of subcontractors shall not diminish the Contractor's obligations to complete the Work in accordance with the Contract. The Contractor shall control and coordinate the Work of its subcontractors.

6.5 The Contractor shall be responsible for informing its subcontractors and suppliers of all the terms, conditions and requirements of the Contract Documents including, but not limited to the General Conditions, Supplementary Conditions, the Drawings and Specifications, Appendix A, and changes made by Addenda.

## ARTICLE 7 - USE OF PREMISES

7.1 If the Premises are occupied, the Contractor, its subcontractors, and their employees shall comply with the regulations governing access to, operation of, and conduct while in or on the Premises and shall perform the Work in such a manner as not to unreasonably interrupt or interfere with the conduct of business.

7.2 Any request received by the Contractor from any source other than the Director or the Director's

Representative to change the Work or its sequence shall be referred to the Director's Representative for determination.

7.3 The Contractor, its subcontractors and their employees shall not have access to or be admitted to any area of the Premises outside the Site except with the written permission of the Director's Representative.

#### ARTICLE 8 - PERMITS AND COMPLIANCE

8.1 The Contractor shall obtain, maintain and pay for all permits and licenses legally required and shall give all notices, pay all fees and comply with all laws, rules and regulations applicable to the Work at no additional cost.

#### ARTICLE 9 - INSPECTION AND ACCEPTANCE

9.1 The Director's Representative will inspect and test the Work at reasonable times at the Site, unless the Director determines to make an inspection or test at a place of production, manufacture or shipment. Such inspection or test shall be conclusive as to whether the material and workmanship inspected or tested conforms to the requirements of the Contract. Such inspection or test shall not relieve the Contractor of responsibility for damage to or loss of the material prior to acceptance, nor in any way affect the continuing rights of the Director to reject the completed Work.

9.2 The Contractor shall, without charge, promptly correct any Work the Director's Representative finds does not conform to the Contract Documents unless in the public interest the Director consents to accept such Work with an appropriate adjustment on the Contract sum and/or to any terms and conditions of the Contract. The Contractor shall promptly remove rejected material from the Premises.

9.3 If the Contractor does not promptly correct rejected Work including the work of other subcontractors destroyed or damaged by removal, replacement, or correction, the Director may (1) correct such Work and charge the cost thereof to the Contractor; or (2) terminate the Contract in accordance with Article 13 of the General Conditions.

9.4 The Contractor shall furnish promptly without additional charge all facilities, labor, material and equipment reasonably needed to perform in a safe and convenient manner such inspections and tests as the Director's Representative requires.

9.5 The Contractor shall keep the Director's Representative informed of the progress of the Contractor's Work and particularly when the Contractor intends to cover Work not yet inspected or tested. All inspection and tests by the Director's Representative shall be performed in such manner as not to unreasonably delay the Work.

9.5.1 The Contractor shall be responsible for all required tests and appropriate test schedules, approvals and inspections pursuant to the Contract Documents.

9.5.2 The Contractor shall be back-charged with any cost of inspection when the Work is not ready at the time specified by the Director's Representative for inspection, or for deficient work that shall require re-testing.

9.6 Should the Director's Representative determine at any time before acceptance of the entire Work to examine Work already completed by removing, uncovering or testing the same, the Contractor shall, on request, promptly furnish all necessary facilities, labor, materials and equipment to conduct such inspection, examination or test. If such Work is found to be defective or nonconforming in any material respect, the Contractor shall defray all the expenses of such examination and satisfactory reconstruction. If the Work is found to meet the requirements of the Contract Documents, the Contractor shall be compensated for the additional services involved in such examination and reconstruction by order on contract and, if completion of the Work has been delayed thereby, shall receive a suitable extension of time.

9.7 No previous inspection or certificates of payment shall relieve the Contractor from the obligation to perform the Work in accordance with the Contract Documents. The final payment shall not relieve the Contractor of the responsibility for failing to comply with the Contract Documents.

9.8 The Contractor shall remedy all defects, paying the cost of any damage to other work or property of the State resulting there from, which shall appear within a period of one year from the date of physical completion.

9.9 Contractor warrants that Product(s) furnished pursuant to this Contract shall, when used in accordance with the Product documentation, be able to accurately process date/time data (including, but not limited to, calculating, comparing, and sequencing) transitions, including leap year calculations. Where a Contractor proposes or an acquisition requires that specific Products must perform as a package or system, this warranty shall apply to the Products as a system.

9.9.1 Where Contractor is providing ongoing services, including but not limited to: i) consulting, integration, code or data conversion, ii) maintenance or support services, iii) data entry or processing, or iv) contract administration services (e.g. billing, invoicing, claim processing), Contractor warrants that services shall be provided in an accurate and timely manner without interruption, failure or error due to the inaccuracy of Contractor's business operations in processing date/time

data (including, but not limited to, calculating, comparing, and sequencing) various date/time transitions, including leap year calculations. Contractor shall be responsible for damages resulting from any delays, errors or untimely performance resulting there from, including but not limited to the failure or untimely performance of such services.

9.9.2 This Date/Time Warranty shall survive beyond termination or expiration of this contract through: a) ninety (90) days or b) the Contractor's or Product manufacturer/developer's stated date/time warranty term, whichever is longer. Nothing in this warranty statement shall be construed to limit any rights or remedies otherwise available under this Contract for breach of warranty.

## ARTICLE 10 - ORDERS ON CONTRACT (CHANGE ORDERS)

10.1 The State may make changes by altering, adding to or deleting from the Work, and adjusting the Contract sum accordingly. All changed Work shall be executed in conformity with the terms and conditions of the Contract Documents unless otherwise provided in the order on contract. Any change in the Contract sum or time for completion of the described work of the order on contract shall be contained in the order on contract. Any change in schedule resulting from an order on contract will be issued in accordance with the provisions of Paragraphs 4.6 and 13.5 of these General Conditions.

10.2 No written or oral instructions shall be construed as directing a change in the Work unless in the form of an order on contract signed by the Contracting Officer. The order on contract shall describe or enumerate the Work to be performed, state the amount (if any) to be added to or deducted from the Contract sum and state the time allowed (if any) for the performance of the changed work. If the extent or cost of the Work is not determinable until after the changed Work is performed, the order on contract shall specify the method for determining the cost and extent of the changed Work when completed. If the Contractor disagrees as to any element of the order on contract, the Contractor shall promptly indicate such disagreement in writing by certified mail directed to the Contracting Officer and shall promptly proceed in accordance with the order on contract. The Contractor's letter of disagreement shall identify by number the order on contract with which the Contractor is disagreeing, the elements with which the Contractor disagrees and a statement as to why there is a disagreement on each element. The letter of disagreement shall be accompanied by documentation of every material element of the Contractor's basis for disagreement. The Contracting Officer shall promptly review the Contractor's letter and supporting documentation and advise the Contractor in writing of any modifications to the order on contract or of the confirmation of the order on contract as issued. The Contracting Officer may, in the exercise of discretion, conduct informal discussions or meetings with the

Contractor and/or State Officials, employees or agents prior to rendering a decision.

10.3 If the Contractor is required to perform Work for which the Contractor believes it is entitled to an order on contract, the Contractor shall give the Director prompt written notice and await instructions before proceeding to execute such Work. The Contractor shall thereafter proceed diligently with the performance of the contract in accordance with the Director's instructions. The Contractor shall maintain complete cost records including but not limited to time and payroll records, material invoices and delivery tickets, equipment rental and purchase invoices for itself and all subcontractors, suppliers and material-men when the Contractor performs work which the Contractor believes is extra or additional work. Failure to maintain such records shall waive any right to extra and additional costs beyond those costs supported by actual cost records.

10.4 The Contracting Officer shall determine the value of any order on contract by one or more of the methods provided in Division 01 - General Requirements.

10.5 Irrespective of the method used or to be used by the State in determining the value of a change order, the Contractor shall after receipt of a request, promptly submit to the State a detailed breakdown of the Contractor's estimate of the value of the omitted or extra work. The Contractor shall submit evidence, satisfactory to the Contracting Officer, to substantiate each and every item that constitutes his proposal for the change. The State shall promptly respond to such submission.

10.5.1 The contractor shall submit a responsive cost proposal to the Director's Representative in proper form subject to the provisions of this Article. The contractor shall respond no later than 30 days from the date of a "request for proposal" from the Director's Representative. Should the contractor fail to respond or submit the required cost proposal within the 30 day requirement, the State shall determine a fair market value for the work proposed and will issue an order on contract or field order to the contract. The Contractor, by failing to respond or provide an acceptable proposal; waives any claim or rights to any extra and or additional costs as determined by the Contracting Officer.

10.6 Unless otherwise specifically provided for in a change order, the compensation specified therein for extra work includes full payment for both the extra work covered thereby and for any damage or expense caused the Contractor by any delays to other work to be done under the Contract resulting from or on account of said extra work, and the Contractor waives all rights to any other compensation for said extra work, damage or expense.

10.7 No order on contract which creates a liability on the State shall be binding unless approved by the Office of the State Comptroller.

#### ARTICLE 11 - SITE CONDITIONS

11.1 If the Contractor encounters subsurface or other latent physical conditions at the Site which differ substantially from those shown, described or indicated in such information provided by the State or from any information which is a public record and which subsurface or other latent physical condition could not have been reasonably anticipated from that information or from the Contractor's own inspection and examination of the Site, the Contractor shall give immediate written notice to the Director before any such condition is disturbed. The Director shall promptly investigate and, if it is determined that the conditions substantially differ from those which should have been reasonably anticipated, shall make such changes in the Drawings and Specifications as may be required. If necessary, the Contract sum and completion date shall be adjusted, to reflect any increase or decrease in the cost of, or time required for, performance of the Contract.

#### ARTICLE 12 - SUSPENSION OF WORK

12.1 The Director may order the Contractor in writing to suspend, delay, or interrupt performance of all or any part of the Work for a reasonable period of time as the Director may determine.

12.2 Upon receipt of a suspension order, the Contractor shall, as soon as practicable, cease performance of the Work as ordered and take immediate affirmative measures to protect such Work from loss or damage.

12.3 The Contractor specifically agrees that a suspension, interruption or delay of the performance of the Work pursuant to this Article for a period or periods not exceeding thirty days in total shall not increase the cost of performance of the Work of this Contract other than costs directly related to demobilization and remobilization for the Work, temporary services costs, equipment rental which cannot be practically suspended and temporary protection measures which are unusual but necessary.

#### ARTICLE 13 - TIME OF COMPLETION AND TERMINATION FOR CAUSE

13.1 All time limits stated in the Contract are of the essence of the Contract.

13.2 Termination for Cause.

13.2.1 If in the judgment of the Group Director, the Contractor fails or refuses to prosecute the Work in accordance with the Contract, or is failing to

complete the Work within the time provided by the Contract, the Group Director may terminate the Contract by written notice. In such event, the Group Director shall order the surety to complete the Work.

13.2.2 If it is determined after the award of the contract that there exists any cause of so serious or compelling a nature, including but not limited to, submission to a contracting agency of a false or misleading statement on a NYS Vendor Responsibility Questionnaire, or in some other form in connection with a bid for or award of this or any other contract or a request for approval of a subcontractor, that it raises questions about the present responsibility of a contractor or subcontractor, the Group Director may terminate the Contract by written notice. In such event, the Group Director may or may not in his sole discretion, order the surety to complete the Work.

13.2.3 The Director will notify the Contractor and Surety that the State is considering declaring the Contractor in default and will arrange a hearing with the Contractor and the Surety to discuss methods of performing and completing the contract work.

13.2.4 If the State formally declares the contractor in default the State will demand upon the Surety to complete any and all remaining work pursuant to the terms of the Contract and the Surety Takeover Guidelines incorporated as Appendix B. The Surety may undertake to perform and complete the work itself, through its agents or through independent contractors approved by the State. The State will agree to pay the balance of the Contract price to the Surety in accordance with the terms and conditions of the Contract or to the designee authorized in writing by the surety upon acceptance of the Surety's completion plan pursuant to Appendix B. incorporated herein.

13.2.5 The surety agrees to complete any investigation into the default of the Contractor and advise the Group Director as to its intended course of action within ten days of receipt of the written notice of default. That notice will detail the underlying reasons for the default and provide pertinent documentation including the surety takeover guidelines of the Contracting Officer. Any request by a surety for execution of a takeover agreement, shall be delivered to the Contracting Officer for consideration, within the same ten day period. No changes in the terms and conditions of the Contract will be considered. All rights remedies and defenses of the parties are reserved and no rights, remedies or defenses of the parties are waived, by virtue of the surety's agreement to assume contract performance under the bond

13.2.6 The Surety may elect to forfeit the remaining penal sum of the Performance Bond within twenty days of notification of default by the State; with no additional penalties imposed, upon the execution of a



release prepared by the State. The State will determine the value of the remaining Work based upon its investigation of the Work in place against payments previously authorized. As soon as practical the Surety will tender payment therefore to the State.

13.2.7 If the surety fails or refuses to complete the Work within twenty five days of the notification of the contractors default or if the Surety fails or refuses to complete the work within the time frames allotted by the State, the Group Director may take over the Work and prosecute it to completion by contract publicly let or otherwise, and may take possession of and utilize in completing the Work, such of the Contractor's materials, equipment and plant as may be on the Site of the Work. Whether or not the right to terminate is exercised, the Contractor and the Surety shall be liable for any damage to the State resulting from the failure or refusal to complete the Work in accordance with the Contract or the failure to complete the Work within the time provided by the Contract.

13.2.8 Should the Surety fail to commence the work the Group Director will notify the Surety that the State is considering declaring the Surety in default and will arrange a hearing with the Surety to discuss methods of performing and completing the contract work. It is the policy of the Office of General Services, Design and Construction Group to let a Contract for the remaining work after the 21<sup>st</sup> day of the demand upon the Surety to complete the Work pursuant to the terms and conditions of the Contract, and the Performance Bond filed with the Office of the State Comptroller.

13.3 The amount of Liquidated Damages shall be the product of \$1,000.00 times the number of days of delay in physical completion of the work. Upon the assessment of such damages the State may withhold the sum of the damages contemplated from payments to avoid an overpayment to any firm where damages would apply.

13.3.1 If the Group Director terminates the Contract, damages shall consist of liquidated damages, if any, until the Work is physically completed, plus any increased costs occasioned the State in completing the Work.

13.3.2 If the Group Director does not terminate the Contract, the damages shall consist of liquidated damages, if any, until the Work is physically completed.

13.4 The Contract shall not be so terminated nor the Contractor charged with resulting damage if:

13.4.1 The delay in the completion of the Work arises from unforeseeable causes beyond the control and without the fault or negligence of the Contractor, including but not restricted to, acts of God, acts of the public enemy, acts of the State in either its

sovereign or contractual capacity, acts of another contractor in the performance of a contract with the State, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, unusually severe weather, or delays of subcontractors or suppliers arising from unforeseeable causes beyond the control and without the fault or negligence of both the Contractor and such subcontractors or suppliers, and

13.4.2 The Contractor notifies the Director in writing of the causes of delay within ten days from when the Contractor knew or ought to have known of any such delay.

13.5 The Director will ascertain the facts and the extent of the delay and extend the time for completing the Work when, in the Director's judgment, the findings of fact justify such an extension, and the Director's findings of fact shall be final and conclusive on the parties.

13.6 If after notice of termination of the Contract, it is determined for any reason the Contractor was not in default or that the delay was excusable, the rights and obligations of the parties shall be the same as if the notice of termination had been issued pursuant to the termination for convenience clause.

13.7 The rights and remedies of the State provided in this Article are in addition to any other rights and remedies provided by law or under this Contract.

13.8 The State, as defined in Article 2 of these General Conditions, reserves the right to terminate this contract in the event it is found that the certification filed by the offerer in accordance with New York State Finance Law §139-k was intentionally false or intentionally incomplete. Upon such finding, the Governmental Entity may exercise its termination right by providing written notification to the offerer in accordance with the written notification terms of the contract.

#### ARTICLE 14 - TERMINATION OF CONTRACTOR'S EMPLOYMENT FOR THE CONVENIENCE OF THE STATE OF NEW YORK

14.1 The Group Director may terminate this Contract whenever the public interest so requires by delivering to the Contractor a notice of termination specifying the extent to which performance of Work under the Contract is terminated and the date upon which such termination becomes effective. Upon receipt of the notice of termination, the Contractor shall act promptly to minimize the expenses resulting from such termination. The State shall pay the Contractor the sum of:

14.1.1 The costs actually incurred by the Contractor, subcontractors, and sub-subcontractors or

their suppliers up to the effective date of such termination, and

14.1.2 The cost of settling and paying claims, provided the concurrence of the Contracting Officer is obtained prior to agreeing to any such settlement, arising out of the termination of Work under subcontracts or orders exclusive of the amounts paid or payable on account of supplies or materials delivered or services furnished by the subcontractor prior to the effective date of the notice of termination of Work under this Contract, which amounts shall be included in the cost on account of which payment is made under 14.1.1 above, and

14.1.3 An amount determined by adding to the amount of the costs under 14.1.1 above a sum equal to 20% (comprised of 10% overhead and 10% profit) thereof, provided, however, that if it appears that the Contractor would have sustained a documentable loss on the entire Contract had it been completed, an appropriate adjustment shall be made reducing the amount to be paid under this Article to reflect the indicated rate of loss.

14.2 In no event shall the Contractor's compensation exceed the total Contract amount.

14.3 The detailed estimate or amount of progress payments made to the Contractor prior to the day termination was effective shall not be conclusive evidence of costs incurred but progress payments shall be offset against any payment which the State makes to the Contractor as a result of such termination.

## ARTICLE 15 - DISPUTES

15.1 The Contractor specifically agrees to submit, in the first instance, any dispute or disagreement relating to the performance of this Contract to the Group Director, who shall render a decision in writing and furnish a copy thereof to the Contractor. The Contractor agrees that this clause does not apply to any dispute or disagreement which involves delay, acceleration, interference or any other act or omission constituting a breach of contract; any matter relating to extensions of time, bonuses or liquidated damages; to the value of any order on contract or field order (issued pursuant to Division 01 - General Requirements); any termination for cause or convenience; or to termination costs allowable pursuant to contract.

15.2 The Contractor must request such decision in writing by certified mail no more than fifteen days after the Contractor knew or ought to have known of the facts which are the basis of the dispute or disagreement. Such writing shall identify the nature of the dispute or disagreement; identify the person who rendered the decision or interpretation involved and the date of the decision or interpretation with which the Contractor disputes or disagrees, attaching a copy of such decision or interpretation; contain a statement of the contractual

basis for the dispute or disagreement; and identify the relief sought.

15.3 The Group Director may cause an investigation to be made of the circumstances involving the dispute or disagreement and may cause a fact-finding proceeding to be conducted before rendering the decision.

15.4 The Contractor agrees that the decision of the Group Director shall be final and conclusive. Nothing in this Contract shall be construed as making final the decision of any administrative official upon a question of law.

## ARTICLE 16 - STATUTORY REQUIREMENTS FOR UTILIZATION OF MINORITY AND WOMEN OWNED BUSINESS ENTERPRISES

16.1 Pursuant to Section 313 of Article 15-A of the Executive Law of the State of New York, the Director of the Division of Minority and Women's Business Development has promulgated rules and regulations (Parts 140 through 145 of Subtitle N of Title 9 New York Code of Rules and Regulations) (the "Regulations") for the purposes of ensuring that certified Minority and Women owned Business Enterprises shall be given the opportunity for meaningful participation in the performance of State contracts and to facilitate the award of a fair share of State contracts and subcontracts to such business enterprises.

16.2 The Contractor shall make a good faith effort to solicit active participation in the Work by enterprises identified in the directory of certified businesses obtainable from the Division of Minority and Women's Business Development, New York State Department of Economic Development.

16.3 The Contractor agrees, as a material condition of this contract, to be bound by the provisions of Section 316 of Article 15-A of the Executive Law of the State of New York which relates to the resolution of disputes which may arise under this Article.

16.4 The Contractor agrees to include the provisions of Paragraphs 16.2 and 16.3 of these General Conditions in every subcontract it enters into as to Work in connection with this Contract in such a manner that the provisions will be binding upon such subcontractor. However, the provisions of this paragraph shall not be binding upon the Contractor or its subcontractors in the performance of work or the provision of services that are unrelated, separate or distinct from this Contract as expressed by its terms.

16.5 The Regulations referred to in Paragraph 16.1 of these General Conditions require, among other things, that a bidder or proposer for a State contract submit a utilization plan which shall identify certified Minority or Women Owned Business Enterprises which the

bidder/proposer intends to use in connection with the performance of the proposed State contract. Such a utilization plan shall be submitted after bids are opened but prior to contract award.

16.5.1 Pursuant to the Regulations: (1) the Commissioner may require the submission by the Contractor of compliance reports relating to the implementation of and adherence to the utilization plan in performing the Contract; (2) the Commissioner shall allow the Contractor to apply for a partial or total waiver of the Minority and Women Owned Business participation requirements; (3) the Contractor may file a complaint with the Executive Director of the Division of Minority and Women's Business Development regarding a denial of a request for waiver of Minority and Women Owned Business participation requirements; (4) the Commissioner may file a complaint with the Executive Director of the Division of Minority and Women's Business Development in the event the Contractor fails to comply with the Minority and Women Owned Business participation requirements set forth in this Contract; and (5) the Commissioner may disqualify the Contractor's bid or proposal as being non-responsive for failure to remedy notified deficiencies contained in the Contractor's utilization plan after an administrative hearing on the record, reviewing all grounds for disqualification stated by the Commissioner and taking into consideration all the criteria set forth in Section 313 of the Executive Law.

16.5.2 The Contractor is referred to the entirety of the provisions of Section 316 of Article 15-A of the Executive Law of the State of New York and of the Regulations for the Contractor's full familiarization with their applicable provisions as terms of this Contract.

## ARTICLE 17 - COORDINATION OF SEPARATE CONTRACTS

17.1 The State may award other contracts which affect the Work of this Contract. In that event, the Contractor shall coordinate its Work with the work of other contractors in such manner as the State may direct. Each contractor shall control and coordinate the work of its subcontractors, if any. The State shall approve or require the modification of the work schedules of all contractors to the end that the Project may be progressed as expeditiously as the case permits.

17.2 If any part of the Work depends for proper execution or results upon the work of any other contractor, the Contractor shall inspect and promptly report in writing to the Director's Representative any defects in such work. The Contractor's failure to inspect and report shall constitute an acceptance of the other contractor's work as fit and proper for the reception of the Contractor's Work.

17.3 The Director's Representative shall issue appropriate directions and take such other measures to coordinate and progress the Work as may be reserved to the State in the Contract, and which an ordinarily reasonable project owner in similar circumstances would be expected to take.

17.4 The award of more than one contract for the Project requires sequential or otherwise interrelated contractor operations, and will involve inherent delays in the progress of any individual contractor's work. Accordingly, the State does not guarantee the unimpeded operations of any contractor. The Contractor acknowledges these conditions, and understands that the Contractor shall bear the risk of all delays caused by the presence or operations of other contractors engaged by the State and delays attendant upon any State-approved construction schedule.

17.5 The State shall not be liable for delays which occur by reason of any contractor's failure to comply with directions of the State or because of the neglect, failure or inability of any contractor to perform its work efficiently.

17.6 The Contractor shall defend, indemnify and hold the State harmless from any and all claims or judgments of damages and from costs and expenses to which the State may be subjected or which it may suffer or incur by reason of or based upon an allegation of the Contractor's failure to promptly comply with the directions of the Director's Representatives.

17.7 Should the Contractor sustain any damage through any act or omission of any other contractor having a contract with the State for the performance of work upon the Site of work which may be necessary to be performed for the proper prosecution of the Work to be performed hereunder, or through any act or omission of a subcontractor of such contractor, the Contractor shall have no claim against the State for such damage, but shall have a right to recover such damage from the other contractor under the provision similar to the following provision which has been or will be inserted in the contract with such other contractors.

17.8 Should any other contractor having or who shall hereafter have a contract with the State for the performance of work upon the Site sustain any damage through any act or omission of the Contractor hereunder or through any act or omission of any subcontractor of the Contractor, the Contractor agrees to reimburse such other contractor for all such damages and to indemnify and hold the State harmless from all such claims.

## ARTICLE 17A - DELAYS

17A.1 For the purposes of this Contract, the term delay includes delay, disruption, interference, inefficiencies, impedance, hindrance and acceleration.

17A.2 The Contractor agrees to make claim only for additional costs as defined in Document 012200, section 1.01, paragraph H from causes listed below, attributable to delay in the performance of this contract, occasioned by any act or omission to act by the State or any of its representatives. The Contractor also agrees that delay from any other cause shall be compensated for solely by an extension of time to complete the performance of the work.

17A.2.1 The failure of the State to take reasonable measures to coordinate and progress the work.

17A.2.2 Extended delays attributable to the State in the review or issuance of orders on contract or field orders, in shop drawing reviews and approvals or as a result of the cumulative impact of multiple orders on contract, which constitute a qualitative change to the project work and which have a verifiable impact on project costs.

17A.2.3 The unavailability of the site for such an extended period of time which the Director determines to significantly affect the scheduled completion of the contract.

17A.2.4 The issuance by the Director of a stop work order relative to a substantial portion of work for a period exceeding thirty days.

17A.3 The Contractor shall provide "notice of claim" of an anticipated claim for delay to the Contracting Officer by personal service or certified mail no more than fifteen days after the Contractor knew or ought to have known of the facts which form the basis of the claim. The Contracting Officer shall acknowledge receipt of the Contractor's notice, in writing, within five days. The Contractor agrees that the State shall have no liability for any damages which accrue more than fifteen days prior to the delivery or mailing of the required notice. The notice shall at a minimum provide a description of any operations that were, are being, or will be delayed, the date(s) and reasons for the delay, and, to the extent known, the information required by Paragraph 17A.6 of these General Conditions. In no case, shall oral notice to the Director's Representative or contracting officer constitute notice under this provision or be deemed to constitute a waiver of the written notice requirement. In no case, shall written notice to the Director's Representative or any other individual other than the Contracting Officer constitute notice under this provision or be deemed to constitute a waiver of the written notice requirement. The Contracting Officer is located at the following location:

Division of Contract Administration  
Contracting Officer  
35<sup>th</sup> Floor, Corning Tower  
Albany, New York 12242

17A.4 Failure by the Contractor to adequately progress the completion of the work will be considered in determining the causes of delay. For any claim asserted under this Article, the Contractor shall keep detailed written records of the costs and shall make them available to the Contracting Officer at any time for the purposes of audit and review. Failure by the Contractor to provide the required written notice or to maintain and furnish records of the costs of such claims to the Contracting Officer shall constitute a waiver of the claim.

17A.5 The provisions of this Article apply only to claims for extra or additional costs attributable to delay and do not preclude determinations by the Director allowing reimbursement for additional costs for extra work pursuant to Article 10 of these General Conditions.

#### 17A.6 REQUIRED CONTENT OF CLAIM SUBMISSION.

17A.6.1 As noted in Paragraph 17A.3 of these General Conditions, all claims for delay shall be submitted in writing to the Contracting Officer and must be in sufficient detail to enable the Contracting Officer to ascertain the basis and the amount of each claim. The following information shall be provided by the Contractor upon request of the Contracting Officer if not previously supplied:

- a. A description of the operations that were delayed, the reasons for the delay and an explanation of how they were delayed.
- b. A detailed factual statement of the claim providing all necessary dates, locations and items of work affected by the claim.
- c. An as-built chart, "Critical Path Method" scheme or other diagram or chart depicting in graphic form how the operations were or are claimed to be adversely affected including the report and conclusions of all engineering and scheduling experts or other consultants, if any.
- d. The date on which actions resulting in the claim occurred or conditions resulting in the claim became evident.
- e. A copy of the approved project schedule and a copy of the "notice of claim" required for the specific claim by Paragraph 17A.3 of these General Conditions.
- f. To the extent known, the name, function, and activity of each State official, employee or agent, involved in, or knowledgeable about facts that gave rise to such claim.
- g. The name, function, and activity of each Contractor or subcontractor officer, or employee, involved in, or knowledgeable about facts that gave rise to such claim.
- h. The identification of any pertinent documents, and the substance of any material oral communication relating to such claim.

i. The amount of additional compensation sought and a breakdown of that amount into the categories specified in Division 01 - General Requirements.

j. If an extension of time is also requested, the specific number of days for which it is sought and the basis for such request as determined by an analysis of the construction progress schedule.

#### 17A.7 REQUIRED CERTIFICATION OF CLAIMS.

17A.7.1 When submitting any notice of claim or claim data, the Contractor must certify in writing and under oath:

a. That supporting data is accurate and complete to the Contractor's best knowledge and belief;

b. That the amount of the claim and the claim itself accurately reflects what the Contractor in good faith believes to be the State's liability.

17A.7.2 If the Contractor is an individual, the certification shall be executed by that individual. If the Contractor is not an individual, the certification shall be executed by a company official in charge of the Contractor's operations pertaining to this contract or an officer or general partner of the Contractor having overall responsibility for the conduct of the Contractor's affairs.

17A.7.3 Failure to timely comply with any of the requirements of Article 17A for the submission of any claim for delay may constitute grounds for denial of such claim.

#### ARTICLE 18 - RESPONSIBILITY FOR DAMAGE

18.1 The Contractor shall faithfully perform and complete all of the Work required by the Contract, and has full responsibility for the following risks:

18.1.1 Loss or damage, direct or indirect, to any property owned by the State or to the Work including the building or structure in which the Work is being performed, or any other construction in progress whether being performed by any other contractor or the State, or to any plant, equipment, tools, materials or property furnished, used, installed or received by the Director under this Contract or any other contract. The Contractor shall bear all such risk of loss or damage, until all of the Work covered by the Contract has been finally accepted. In the event of such loss or damage the Contractor shall forthwith repair, replace, and make good any such loss or damage without additional cost.

18.1.2 Injury to persons (including death resulting there from), or damage to property caused by an occurrence arising out of the performance of this Contract for which the Contractor may be legally liable under the laws of torts.

18.2 The Contractor, however, shall not be responsible for damages resulting from faulty design or from willful acts of State officials or employees or from negligence resulting solely from acts or omissions of the State, its officers or employees. Nothing herein shall vest in third parties any right of action beyond such as may legally exist irrespective of this Article.

18.3 The Contractor shall indemnify and save harmless the State, its employees and agents from suits, actions, damages, and costs of every name and description relating to the performance of this Contract during its prosecution and until the acceptance thereof, and the State may retain such moneys from the amount due the Contractor as may be necessary to satisfy any claim for damages recovered against the State. The Contractor's obligations under this paragraph shall not be deemed waived by the failure of the State to retain the whole or any part of such moneys due the Contractor, nor shall such obligation be deemed limited or discharged by the enumeration or procurement of any insurance for liability for damages imposed by law upon the Contractor, subcontractor or the State.

#### ARTICLE 19 - INSURANCE - BUILDER'S RISK, LIABILITY AND WORKERS' COMPENSATION

19.1 Before commencing the Work and until the established Physical Completion date, all insurance required by the Contract shall be obtained at the sole cost and expense of the Contractor; and the Contractor shall furnish to the Contracting Officer a Certificate of Insurance in a form satisfactory to the Contracting Officer showing that the Contractor has complied with this Article. Insurance shall be maintained with insurance carriers licensed to do business in New York State and acceptable to the Contracting Officer; shall be primary and non-contributing to any insurance or self insurance maintained by OGS; and shall be endorsed to provide written notice be given to the Contracting Officer at least thirty days prior to the cancellation, non-renewal, or material alteration of such policies, which notice, evidenced by return receipt of United States Certified Mail, any notice shall be addressed to:

Division of Contract Administration  
Director  
35<sup>th</sup> Floor, Corning Tower  
Albany, New York 12242

19.1.1 The endorsement shall name The People of the State of New York, its officers, agents, employees and the assigned construction manager as additional insureds there under. This additional insured shall be primary and non-contributory. (General Liability Additional Insured Endorsement shall be on Insurance Service Office's (ISO) form number CG 20 10 11 85 and a copy of which shall be furnished along with the Certificate of Insurance.) The Contracting Officer may modify the provisions of this Article when deemed

in the best interest of the State by order on contract or field order.

19.1.2 The Contractor, throughout the term of this Contract, or as otherwise required by this Contract, shall obtain and maintain in full force and effect on an occurrence form, the following insurance with limits not less than those described in this article, and as required by the terms of this Contract, or as required by law, whichever is greater. If such insurance contains an aggregate limit, it shall apply separately on a per job, per location basis.

19.1.3 The Contractor shall be solely responsible for the payment of all deductibles and Self Insured Retentions.

19.1.4 Not less than thirty days prior to the expiration date or renewal date of any insurance policies reflected on such certificates, the Contractor shall supply OGS updated replacement Certificates of Insurance, and amendatory endorsements.

19.2 The kinds and amount of insurance is as follows:

19.2.1 Workers' Compensation Insurance and Disability Benefits Law. A policy covering the obligations of the Contractor in accordance with the Workers' Compensation Law and the Disability Benefits Law covering all operations under the Contract, whether performed by the Contractor or by its subcontractor.

19.2.2 Commercial General Liability, and if necessary, Commercial Umbrella Liability Insurance with a limit of not less than \$2,000,000 each occurrence. Such liability shall be written on the ISO occurrence form CG 00 01, or a substitute form providing equivalent coverages and shall cover liability resulting in Bodily Injury, Property Damage, Personal Injury or loss of use arising from premises operations, independent contractors, products-completed operations, broad form property damage, personal & advertising injury, cross liability coverage, liability assumed in a contract (including the tort liability of another assumed in a contract) and explosion, collapse & underground coverage.

If such insurance contains an aggregate limit, it shall apply separately on a per job, per location basis.

19.2.3 Comprehensive Business Automobile Liability, and if necessary, Commercial Umbrella Liability Insurance with a limit of not less than \$2,000,000 each accident. Such insurance shall cover liability arising out of any automobile including owned, leased, hired and non-owned automobiles.

19.2.4 Builder's Risk: The Contractor shall be liable for any and all damages and losses to the Project prior to the State of New York's acceptance of

the Project as fully completed except that the Contractor shall not be liable for:

19.2.4.1 Losses covered by the Builder's Risk property insurance provided by the State of New York; except that the Contractor shall be liable for the applicable deductible.

19.2.4.2 All policies shall be issued by insurance companies licensed to conduct such business under the laws of the State of New York, shall be written for the benefit of the State of New York and for the Contractor as their interests may appear, and shall run until the contract physical completion date. The State of New York must be listed as loss payee pursuant to this policy. Policies expiring on a fixed date before physical completion must be renewed and re-filed not less than thirty days before such expiration date.

19.2.5 If the work involves abatement, removal, repair, replacement, enclosure, encapsulation and/or disposal of any petroleum, petroleum product, hazardous material or substance including asbestos, lead or mold, and those as defined by applicable State and federal laws and regulations, the Contractor shall procure, or otherwise obtain through an approved subcontractor, and maintain in full force and effect throughout the term of the contract, and for two years after completion hereof, pollution legal liability insurance with limits of not less than \$5,000,000, providing coverage for bodily injury and property damage, including loss of use of damaged property or of property that has not been physically injured. Such policy shall provide coverage for actual, alleged or threatened emission, discharge, dispersal, seepage, release or escape of pollutants, including any loss, cost or expense incurred as a result of any cleanup of pollutants or in the investigation, settlement or defense of any claim, suit, or proceedings against OGS arising from Contractor's work. The State of New York shall be named as additional insured and this shall be primary.

19.2.5.1 If automobiles are to be used for transporting hazardous materials, the Contractor shall provide pollution liability broadened coverage for covered autos (endorsement CA 99 48) as well as proof of MCS 90.

19.3 The Contractor may provide the required proof of insurance on industry forms provided that no other endorsements exclude, delete or restrict those coverage's provided for by this article. It is required that companies affording coverage list the company name in full as filed with the New York State Insurance Department. The contract number and project location must be provided in order to approve the certificate.

19.4 Should the Contractor fail to provide or maintain any insurance required by law the Contract will be considered null and void. Further, no contractor is

permitted to access the project site without providing proof of proper insurance to the Contracting Officer or his designated representative. No payments will be authorized by the Contracting Officer to any firm who fails to comply with the provisions of this Article.

## ARTICLE 20 - OCCUPANCY PRIOR TO COMPLETION AND ACCEPTANCE

20.1 The State shall have the right to take possession of or use any completed or partially completed portion of the Work. Written notice of such possession shall be given to the Contractor by the Director. The notice shall identify the date when such possession shall commence and the area, equipment or system involved. Written notice shall also be given the Contractor for any cessation of such possession by the State. Such possession or use shall not be deemed an acceptance of any Work. While the State is in such possession, the Contractor, notwithstanding the provisions of Article 18 of the Contract, shall be relieved of the responsibility for loss or damage to the Work except for that resulting from the Contractor's fault or negligence. If such possession or use by the State delays the progress of the Work or causes additional expense to the Contractor, an adjustment in the Contract price and/or the time of completion shall be made and the Contract modified in writing accordingly. The provisions relating to an adjustment in the Contract price or the time of completion contained in this paragraph shall not apply to occupancy or possession after Substantial Completion.

## ARTICLE 21 - PAYMENT

21.1 The Contractor shall submit monthly, or at more frequent intervals if permitted in writing by the Contracting Officer, a requisition for a progress payment to the designated payment office for Work performed and materials furnished up to the date of the requisition, less any amount previously paid to the Contractor. Except as otherwise provided by this Contract, the Contracting Officer shall approve and cause to be paid the requisition for the progress payment less an amount necessary to satisfy any claims, liens or judgments against the Contractor which have not been suitably discharged and less any amount authorized by law to be retained. The requisition shall be in such form and supported by such evidence as the Contracting Officer may reasonably require. The designated payment office is listed as follows:

Division of Contract Administration  
Bureau of Contract Performance  
35<sup>th</sup> Floor, Corning Tower  
Albany, New York 12242

21.1.1 For those contracts designated as Labor and Material reimbursement or similar type contracts, the contractor shall submit to the Contract Payment Audit Group no later than 60 days from the period of when the work occurred, acceptable proof of labor and material

costs specific to the approved scope of work as verified by the Directors Representative, to the Contracting Officer for audit, verification and approval prior to the submission of any payment. The Contract Payment Audit Group is located at the following location:

Division of Contract Administration  
Contract Payment Audit Group  
35<sup>th</sup> Floor, Corning Tower  
Albany, New York 12242

21.1.2 The submittal of cost for reimbursement to the Contractor shall be in such form and supported by such evidence as the Contracting Officer may reasonably require.

21.1.3 For those contracts designated as Electronic Contractor Requisition (ECR) eligible, if the contractor agrees to participate (participation is not mandatory – a contractor may still elect to submit paper requisitions), the contractor shall provide an Electronic Contractor Requisition (ECR) Program Certification form which shall become part of this agreement. The contractor further certifies that the individual certifying the requisition is duly authorized to undertake requisitioning transactions. The contractor understands that the State will rely on the information disclosed in the contractor's requisition consistent with all of the provisions of this Article. A contractor need not submit electronic requisitions in order to receive electronic payments.

21.2 The Director or the Contracting Officer may refuse to approve the requisition or a portion of it if the Contractor is failing or refusing to prosecute the Work in accordance with the Contract.

21.3 Payment will be made for approved materials not yet incorporated in the Work which are in short and/or critical supply and for materials determined to be specifically fabricated for the project. Requisitions which require payment for materials shall be accompanied by a notarized statement certifying that the materials for which payment is requisitioned are the Contractor's property and have been suitably stored and insured. The Contractor shall provide such evidence of the value of the material stored as the Contracting Officer may reasonably require. The Contractor shall have full continuing responsibility to insure and protect such materials and maintain them in proper condition to fulfill Contract requirements when installed.

21.4 When the Work or major milestones thereof as contemplated by the terms of this Contract are substantially completed, the Contractor shall submit to the Contracting Officer a requisition for payment of the remaining amount of the Contract balance. Upon receipt of such requisition the Contracting Officer shall, except as otherwise provided by this Contract, approve and cause to be paid the remaining amount of the Contract balance less two times the value of any remaining items

to be completed and an amount necessary to satisfy any claims, liens or judgments against the Contractor which have not been suitably discharged. As the remaining items of Work are satisfactorily completed or corrected, the Contracting Officer shall cause to be paid, upon receipt of a requisition, for these remaining items less an amount necessary to satisfy any claims, liens or judgments against the Contractor which have not been suitably discharged.

21.5 No more than 60 days after the issuance of the Physical Completion Report, the Contractor shall submit to the Contracting Officer or his designated representative a requisition for payment of the remaining Contract balance. Upon receipt of this requisition, the Contracting Officer shall, except as otherwise provided by this Contract, approve and cause such requisition to be paid less any amount necessary to satisfy any claims, liens or judgments against the Contractor which have not been suitably discharged. The Contractor waives any claim or right to payment of any contract balance which has not been requisitioned for payment within 60 days of the issuance of the Physical Completion Report.

21.6 The final certificate letter will not be issued until all the labor and material required by the Contract has been furnished and completed, all disputes and claims relating to the performance of the Contract considered and disposed of and all accounts for extra work and materials and allowances for omissions have been rendered and considered. The Contractor waives any claim or right to additional compensation which has not been submitted in writing via certified or registered mail to the Contracting Officer pursuant to Article 17A, within thirty days of the issuance of the Physical Completion Report.

21.7 The final certificate letter will constitute the acceptance of the Work by the State, except as to Work thereafter found to be defective. The date of such certificate shall be regarded as the date of acceptance of the Work.

21.8 No payment will be made to a foreign Contractor until it furnishes satisfactory proof that it has paid all taxes required of foreign Contractors under the provisions of the New York State Tax Law. A foreign Contractor as used in this paragraph shall mean a Contractor denominated "foreign" by the New York State Tax Law.

21.9 The contractor is advised that consistent with Subdivision 3-a, of Section 220 of the Labor Law, the filing of certified payroll records is a condition precedent to payment of any sums due and owing to any person performing work on this project. The failure to file pursuant to this section will result in a payment delay until such time as the filing occurs.

21.10 The Contractor acknowledges that it will not receive payment on any requests for payment unless the contractor complies with the State Comptroller's electronic payment deposit procedures. Payments requested by the contractor will only be facilitated via electronic deposit, except where the Commissioner has expressly authorized payment by paper check.

## ARTICLE 22 - AUDITS AND RECORDS

22.1 The Group Director, the Comptroller or their representatives shall have the right to examine all books, records, documents, and other data of the Contractor, subcontractors, material-men or suppliers relating to the bidding, pricing or performance of this Contract or any change or modification thereto for the purpose of evaluating the accuracy, completeness, and currency of the cost or pricing data submitted. This right of examination shall extend to all documents necessary to permit adequate evaluation of the cost or pricing data submitted along with the computations and projections used therein.

22.2 The above materials shall be made available at the office of the Contractor, subcontractors, material-men or suppliers at all reasonable times for inspection, audit or reproduction until the expiration of six years from the date of the final certificate for the Contract.

22.3 If this Contract is completely or partially terminated, the records relating to the Work terminated shall be made available for a period of six years from the date of any resulting final settlement.

22.4 Records which relate to the Disputes Clause of this Contract or litigation or the settlement of claims arising out of the performance of this Contract shall be made available until such appeals, litigation or claims have been disposed of.

22.5 The Contractor shall insert a clause containing all of the provisions of Paragraphs 22.1 to 22.4 of these General Conditions in all subcontracts or purchase orders issued hereunder.

22.6 The Contractor shall make available to the Contracting Officer, upon written request, all records required to be kept by this Contract or by Article 3-A of the Lien Law. The failure to provide said records upon the receipt of the written request shall bar any recovery for claimed extra or additional costs under this Contract.

## ARTICLE 23 – LABOR LAW PROVISIONS

23.1 The contractor shall post, in a location designated by the State, a copy of the New York State Department of Labor schedules of prevailing wages and supplements for this Project, a copy of all re-determinations of such schedules for the Project, the Workers' Compensation Law Section 51 notice, all other



notices required by law to be posted at the Site, the Department of Labor notice that this Project is a public work project on which each worker is entitled to receive the prevailing wages and supplements for the occupation at which he or she is working, and all other notices which the State directs the contractor to post. The contractor shall provide a surface for such notices which is satisfactory to the State. The contractor shall maintain such notices in a legible manner and shall replace any notice or schedule which is damaged, defaced, illegible or removed for any reason. The contractor shall post such notices before commencing any Work on the Site and shall maintain such notices until all Work on the Site is complete.

23.2 The contractor shall distribute to each worker for this Contract a notice, in a form provided by the State, that this Project is a public work project on which each worker is entitled to receive the prevailing wage and supplements for the occupation at which he or she is working. Worker includes employees of contractor and all Subcontractors and all employees of Suppliers entering the Site. Such notice shall be distributed to each worker before he or she starts performing any Work of this Contract. At the time of distribution, the contractor shall have each worker sign a statement, in a form provided by the State, certifying that the worker has received the notice required by this section, which signed statement shall be maintained with the payroll records required by Paragraph 23.3 of these General Conditions.

23.3 The contractor shall maintain on the Site the original certified payroll or certified transcripts thereof which the contractor and all of its Subcontractors are required to maintain pursuant to New York Labor Law Section 220. The contractor shall maintain with the payrolls or transcripts thereof, the statements signed by each worker pursuant to Paragraph 23.2 of these General Conditions.

23.4 A contractor or subcontractor who is required under New York Labor Law Section 220 to maintain transcripts of payroll records must submit to the contracting agency a transcript of the original payroll record within thirty days of issuance of its first payroll and every thirty days, thereafter. The copy of the payroll record must be subscribed and affirmed as true under penalty of perjury. The copy must include the contract number and should be directed to the Director's Representative at the job site. The Director's Representative is hereby designated as the individual responsible for the receipt, collection and review for authenticity of payroll records filed for this contract, consistent with Article 23.4, General Conditions and subparagraph (iii) and (iv) Section 220 Labor Law.

23.5 In accordance with New York Labor Law §222-H, the contractor agrees where the total cost of all work to be performed under the contract is at least two hundred fifty thousand dollars; all laborers, workers, and

mechanics employed in the performance of this contract on the public work site, either by the contractor, sub-contractor or other person doing or contracting to do the whole or a part of the work contemplated by this contract, shall be certified prior to performing any work on the project as having successfully completed a course in construction safety and health approved by the United States department of labor's occupational safety and health administration that is at least ten hours in duration.

23.6 In accordance with New York Labor Law § 220 (3) (a), the Contractor and every sub-contractor agrees to notify all laborers, workers or mechanics in their employ in writing of the prevailing rate of wage for their particular job classification. Such notification shall be given to every laborer, worker or mechanic on their first pay stub and with every pay stub thereafter. At the beginning of performance of every public works contract, and with the first paycheck after July first of each year, the Contractor and every sub-contractor shall notify all laborers, workers, and mechanics in their employ in writing, in accordance with such form as is prescribed by the department, of the telephone number and address for the department. The notice shall also inform each laborer, worker, or mechanic of his or her right to contact the department or some other representative if, at any time while working for the public works contractor or sub-contractor, he or she does not receive the proper prevailing rate of wages or supplements for his or her particular job classification that he or she is entitled to receive under the contract.

#### ARTICLE 24 - STATUTORY REQUIREMENTS FOR RESTRICTIONS ON CONTACTS DURING THE PROCUREMENT PROCESS AND DISCLOSURE OF CONTACTS AND RESPONSIBILITY OF OFFERERS MISCELLANEOUS PROVISIONS

24.1 New York State Finance Law §139-k requires that every procurement contract award subject to the provisions of State Finance Law §139-k or §139-j shall contain a certification by the offerer that all information provided to the procuring governmental agency with respect to State Finance Law §139-k is complete, true and accurate. The Contractor shall provide that certification in his contract or agreement.

#### 24.2 New York State Finance Law

24.2.1 New York State Finance Law § 139-k(2) obligates a Governmental Entity to obtain specific information regarding prior non-responsibility determinations. This information must be collected in addition to the information that is separately obtained pursuant to State Finance Law § 163 (9). In accordance with State Finance Law § 139-k, an offerer must be asked to disclose whether there has been a finding of non-responsibility made within the previous four (4) years by any Governmental Entity due to: (a) a violation of State Finance Law § 139-j or (b) the intentional

provision of false or incomplete information to a Governmental Entity.

24.2.2 As part of its responsibility determination, State Finance Law § 139-k(3) mandates consideration of whether an offerer fails to timely disclose or complete information regarding the above non-responsibility determination. In accordance with law, no procurement contract shall be awarded to any offerer that fails to timely disclose accurate or complete information under this section, unless a finding is made that the award of the Procurement Contract to the Offerer is necessary to protect public property or public health safety, and that the Offerer is the only source capable of supplying the required Article of Procurement within the necessary timeframe. The required forms to be completed by the offerer must be submitted to the Governmental Entity conducting the government procurement. The Governmental Entity will have included the disclosure request in its solicitation of proposals or bid documents or specifications of contract documents, as applicable, for procurement contracts.

## ARTICLE 25 – MISCELLANEOUS PROVISIONS

25.1 Appendix A, standard clauses for all N.Y. State contracts, is attached hereto and is made a part of this agreement as if set forth herein.

25.2 If, in carrying out this Work, a harmful dust hazard is created for which appliances or methods for the elimination of harmful dust have been approved by the Board of Standards and Appeals, then the Contractor shall install, maintain and effectively operate such appliances and methods during the life of this Contract; and in case of Contractor's failure to comply, as provided by Section 222-a of the Labor Law, the Contract shall be void.

25.3 **RETAINED PERCENTAGES:** The Contractor agrees that, if the Contract Documents for this Contract includes Performance and Payment Bonds, the State shall retain five percent of the amount of each progress payment in accordance with Section 139-f of the State Finance Law. The Contractor further agrees that, if the Contract Documents for this Contract do not include Performance and Payment Bonds, the State shall retain ten percent of the amount of each progress payment in accordance with Section 139-f of the State Finance Law.

25.4 **DOMESTIC STEEL:** The Contractor agrees, that if the value of this contract exceeds \$100,000 all structural steel, reinforcing steel and other major steel items to be incorporated in the Work of this Contract shall be produced and made in whole or substantial part in the United States, its territories or possessions.

25.5 **COMMENCEMENT OF ACTIONS:** The time, as prescribed by law, within which an action on the contract against the Contractor must be commenced shall

be computed from the completion of physical work. The Contractor may notify the State in writing that the physical work of the contract has been completed by specifying a completion date, which date shall be no more than thirty days previous to the date of such notice. The completion date set forth in such notice shall be deemed the date of completion of the physical work unless the State, within thirty days of receipt of such notice, notifies the Contractor in writing of its disagreement. Any notice pursuant to this paragraph shall be sent by the Contractor by Certified Mail and addressed to:

Division of Contract Administration  
Contracting Officer  
35<sup>th</sup> Floor, Corning Tower  
Albany, New York 12242

25.5.1 In the event that the Contractor fails to send the notice provided for herein or the State disagrees in the manner provided for herein, the date of completion of the physical work shall be determined in any other manner provided by law.

25.6 **WORKER'S COMPENSATION LAW:** In accordance with Worker's Compensation Law (WCL) § 141-b (Suspension and Debarment), any person subject to a final assessment of civil fines or penalties or a stop-work order, or that has been convicted of a misdemeanor for a violation of WCL §§ 26 (Enforcement of Payment in Default), 52 (Effect of Failure to Secure Compensation) or 131 (Payroll Records), and any substantially-owned affiliated entity of such person, shall be ineligible to submit a bid on or be awarded any such public work contract or subcontract with the State, any municipal corporation or public body for a period of one (1) year from the final determination or conviction. Any person convicted of a felony under Article 8 (Administration) of the WCL, or a misdemeanor under WCL §§ 125 (Job Description Prohibited Based on Prior Receipt of Benefits) and 125-a (Civil Enforcement) shall be ineligible to submit a bid or be awarded any public work contract or subcontract with the State, any municipal corporation or public body for a period of five (5) years from such conviction.

25.7 **ENVIRONMENTAL CONSERVATION LAWS:** The Contractor certifies and warrants that all heavy duty vehicles, as defined in New York State Environmental Law (ECL) section 19-0323, to be used under this Contract, will comply with the specifications and provisions of ECL section 19-0323 and any regulations promulgated pursuant thereto, which requires the use of BART and ULSD, unless specifically waived by NYSDEC. Qualification for a waiver under this law will be the responsibility of the Contractor.

25.8 **REPORTING OF ILLEGAL ACTIVITY:** During the term of the contract, the Contractor agrees to report any observed or suspected illegal activity of its employees, agents or other third parties, to the

Contracting Officer at 518-474-0201, the Group Director, OGS Legal Services, the State Inspector General or other law enforcement agency. Failure to report criminal conduct associated with a contract awarded by the Office of General Services, will be considered a material breach of the contract and may provide grounds for disqualification of the subject

Contractor or Subcontractor for award of future contracts. The Contractor will include the provisions of this section in every subcontract, in such a manner that the provisions will be binding upon each Subcontractor as to work performed in connection with the State contract.

**APPENDIX A**

**STANDARD CLAUSES FOR NEW YORK STATE CONTRACTS**

**PLEASE RETAIN THIS DOCUMENT  
FOR FUTURE REFERENCE.**

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**STANDARD CLAUSES FOR NYS CONTRACTS**

The parties to the attached contract, license, lease, amendment or other agreement of any kind (hereinafter, "the contract" or "this contract") agree to be bound by the following clauses which are hereby made a part of the contract (the word "Contractor" herein refers to any party other than the State, whether a contractor, licensor, licensee, lessor, lessee or any other party):

**1. EXECUTORY CLAUSE.** In accordance with Section 41 of the State Finance Law, the State shall have no liability under this contract to the Contractor or to anyone else beyond funds appropriated and available for this contract.

**2. NON-ASSIGNMENT CLAUSE.** In accordance with Section 138 of the State Finance Law, this contract may not be assigned by the Contractor or its right, title or interest therein assigned, transferred, conveyed, sublet or otherwise disposed of without the State's previous written consent, and attempts to do so are null and void. Notwithstanding the foregoing, such prior written consent of an assignment of a contract let pursuant to Article XI of the State Finance Law may be waived at the discretion of the contracting agency and with the concurrence of the State Comptroller where the original contract was subject to the State Comptroller's approval, where the assignment is due to a reorganization, merger or consolidation of the Contractor's business entity or enterprise. The State retains its right to approve an assignment and to require that any Contractor demonstrate its responsibility to do business with the State. The Contractor may, however, assign its right to receive payments without the State's prior written consent unless this contract concerns Certificates of Participation pursuant to Article 5-A of the State Finance Law.

**3. COMPTROLLER'S APPROVAL.** In accordance with Section 112 of the State Finance Law, if this contract exceeds \$50,000 (or \$75,000 for State University of New York or City University of New York contracts for goods, services, construction and printing, and \$150,000 for State University Health Care Facilities) or if this is an amendment for any amount to a contract which, as so amended, exceeds said statutory amount, or if, by this contract, the State agrees to give something other than money when the value or reasonably estimated value of such consideration exceeds \$25,000, it shall not be valid, effective or binding upon the State until it has been approved by the State Comptroller and filed in his office. Comptroller's approval of contracts let by the Office of General Services, either for itself or its customer agencies by the Office of General Services Business Services Center, is required when such contracts exceed \$85,000. Comptroller's approval of contracts established as centralized contracts through the Office of General Services is required when such contracts exceed

\$125,000, and when a purchase order or other procurement transaction issued under such centralized contract exceeds \$200,000.

**4. WORKERS' COMPENSATION BENEFITS.** In accordance with Section 142 of the State Finance Law, this contract shall be void and of no force and effect unless the Contractor shall provide and maintain coverage during the life of this contract for the benefit of such employees as are required to be covered by the provisions of the Workers' Compensation Law.

**5. NON-DISCRIMINATION REQUIREMENTS.** To the extent required by Article 15 of the Executive Law (also known as the Human Rights Law) and all other State and Federal statutory and constitutional non-discrimination provisions, the Contractor will not discriminate against any employee or applicant for employment, nor subject any individual to harassment, because of age, race, creed, color, national origin, citizenship or immigration status, sexual orientation, gender identity or expression, military status, sex, disability, predisposing genetic characteristics, familial status, marital status, or domestic violence victim status or because the individual has opposed any practices forbidden under the Human Rights Law or has filed a complaint, testified, or assisted in any proceeding under the Human Rights Law. Furthermore, in accordance with Section 220-e of the Labor Law, if this is a contract for the construction, alteration or repair of any public building or public work or for the manufacture, sale or distribution of materials, equipment or supplies, and to the extent that this contract shall be performed within the State of New York, Contractor agrees that neither it nor its subcontractors shall, by reason of race, creed, color, disability, sex, or national origin: (a) discriminate in hiring against any New York State citizen who is qualified and available to perform the work; or (b) discriminate against or intimidate any employee hired for the performance of work under this contract. If this is a building service contract as defined in Section 230 of the Labor Law, then, in accordance with Section 239 thereof, Contractor agrees that neither it nor its subcontractors shall by reason of race, creed, color, national origin, age, sex or disability: (a) discriminate in hiring against any New York State citizen who is qualified and available to perform the work; or (b) discriminate against or intimidate any employee hired for the performance of work under this contract. Contractor is subject to fines of \$50.00 per person per day for any violation of Section 220-e or Section 239 as well as possible termination of this contract and forfeiture of all moneys due hereunder for a second or subsequent violation.

**6. WAGE AND HOURS PROVISIONS.** If this is a public work contract covered by Article 8 of the Labor Law or a building service contract covered by Article 9 thereof, neither Contractor's employees nor the

employees of its subcontractors may be required or permitted to work more than the number of hours or days stated in said statutes, except as otherwise provided in the Labor Law and as set forth in prevailing wage and supplement schedules issued by the State Labor Department. Furthermore, Contractor and its subcontractors must pay at least the prevailing wage rate and pay or provide the prevailing supplements, including the premium rates for overtime pay, as determined by the State Labor Department in accordance with the Labor Law. Additionally, effective April 28, 2008, if this is a public work contract covered by Article 8 of the Labor Law, the Contractor understands and agrees that the filing of payrolls in a manner consistent with Subdivision 3-a of Section 220 of the Labor Law shall be a condition precedent to payment by the State of any State approved sums due and owing for work done upon the project.

**7. NON-COLLUSIVE BIDDING CERTIFICATION.**

In accordance with Section 139-d of the State Finance Law, if this contract was awarded based upon the submission of bids, Contractor affirms, under penalty of perjury, that its bid was arrived at independently and without collusion aimed at restricting competition. Contractor further affirms that, at the time Contractor submitted its bid, an authorized and responsible person executed and delivered to the State a non-collusive bidding certification on Contractor's behalf.

**8. INTERNATIONAL BOYCOTT PROHIBITION.**

In accordance with Section 220-f of the Labor Law and Section 139-h of the State Finance Law, if this contract exceeds \$5,000, the Contractor agrees, as a material condition of the contract, that neither the Contractor nor any substantially owned or affiliated person, firm, partnership or corporation has participated, is participating, or shall participate in an international boycott in violation of the federal Export Administration Act of 1979 (50 USC App. Sections 2401 et seq.) or regulations thereunder. If such Contractor, or any of the aforesaid affiliates of Contractor, is convicted or is otherwise found to have violated said laws or regulations upon the final determination of the United States Commerce Department or any other appropriate agency of the United States subsequent to the contract's execution, such contract, amendment or modification thereto shall be rendered forfeit and void. The Contractor shall so notify the State Comptroller within five (5) business days of such conviction, determination or disposition of appeal (2 NYCRR § 105.4).

**9. SET-OFF RIGHTS.** The State shall have all of its common law, equitable and statutory rights of set-off. These rights shall include, but not be limited to, the State's option to withhold for the purposes of set-off any moneys due to the Contractor under this contract up to any

amounts due and owing to the State with regard to this contract, any other contract with any State department or agency, including any contract for a term commencing prior to the term of this contract, plus any amounts due and owing to the State for any other reason including, without limitation, tax delinquencies, fee delinquencies or monetary penalties relative thereto. The State shall exercise its set-off rights in accordance with normal State practices including, in cases of set-off pursuant to an audit, the finalization of such audit by the State agency, its representatives, or the State Comptroller.

**10. RECORDS.** The Contractor shall establish and maintain complete and accurate books, records, documents, accounts and other evidence directly pertinent to performance under this contract (hereinafter, collectively, the "Records"). The Records must be kept for the balance of the calendar year in which they were made and for six (6) additional years thereafter. The State Comptroller, the Attorney General and any other person or entity authorized to conduct an examination, as well as the agency or agencies involved in this contract, shall have access to the Records during normal business hours at an office of the Contractor within the State of New York or, if no such office is available, at a mutually agreeable and reasonable venue within the State, for the term specified above for the purposes of inspection, auditing and copying. The State shall take reasonable steps to protect from public disclosure any of the Records which are exempt from disclosure under Section 87 of the Public Officers Law (the "Statute") provided that: (i) the Contractor shall timely inform an appropriate State official, in writing, that said records should not be disclosed; and (ii) said records shall be sufficiently identified; and (iii) designation of said records as exempt under the Statute is reasonable. Nothing contained herein shall diminish, or in any way adversely affect, the State's right to discovery in any pending or future litigation.

**11. IDENTIFYING INFORMATION AND PRIVACY NOTIFICATION.**

(a) Identification Number(s). Every invoice or New York State Claim for Payment submitted to a New York State agency by a payee, for payment for the sale of goods or services or for transactions (e.g., leases, easements, licenses, etc.) related to real or personal property must include the payee's identification number. The number is any or all of the following: (i) the payee's Federal employer identification number, (ii) the payee's Federal social security number, and/or (iii) the payee's Vendor Identification Number assigned by the Statewide Financial System. Failure to include such number or numbers may delay payment. Where the payee does not have such number or numbers, the payee, on its invoice or Claim for Payment, must give the reason or reasons why the payee does not have such number or numbers.

(b) Privacy Notification. (1) The authority to request the above personal information from a seller of goods or services or a lessor of real or personal property, and the authority to maintain such information, is found in Section 5 of the State Tax Law. Disclosure of this information by the seller or lessor to the State is mandatory. The principal purpose for which the information is collected is to enable the State to identify individuals, businesses and others who have been delinquent in filing tax returns or may have understated their tax liabilities and to generally identify persons affected by the taxes administered by the Commissioner of Taxation and Finance. The information will be used for tax administration purposes and for any other purpose authorized by law. (2) The personal information is requested by the purchasing unit of the agency contracting to purchase the goods or services or lease the real or personal property covered by this contract or lease. The information is maintained in the Statewide Financial System by the Vendor Management Unit within the Bureau of State Expenditures, Office of the State Comptroller, 110 State Street, Albany, New York 12236.

## **12. EQUAL EMPLOYMENT OPPORTUNITIES FOR MINORITIES AND WOMEN.**

In accordance with Section 312 of the Executive Law and 5 NYCRR Part 143, if this contract is: (i) a written agreement or purchase order instrument, providing for a total expenditure in excess of \$25,000.00, whereby a contracting agency is committed to expend or does expend funds in return for labor, services, supplies, equipment, materials or any combination of the foregoing, to be performed for, or rendered or furnished to the contracting agency; or (ii) a written agreement in excess of \$100,000.00 whereby a contracting agency is committed to expend or does expend funds for the acquisition, construction, demolition, replacement, major repair or renovation of real property and improvements thereon; or (iii) a written agreement in excess of \$100,000.00 whereby the owner of a State assisted housing project is committed to expend or does expend funds for the acquisition, construction, demolition, replacement, major repair or renovation of real property and improvements thereon for such project, then the following shall apply and by signing this agreement the Contractor certifies and affirms that it is Contractor's equal employment opportunity policy that:

(a) The Contractor will not discriminate against employees or applicants for employment because of race, creed, color, national origin, sex, age, disability or marital status, shall make and document its conscientious and active efforts to employ and utilize minority group members and women in its work force on State contracts and will undertake or continue existing programs of affirmative action to ensure that minority group members and women are afforded equal employment opportunities without discrimination. Affirmative action shall mean

recruitment, employment, job assignment, promotion, upgradings, demotion, transfer, layoff, or termination and rates of pay or other forms of compensation;

(b) at the request of the contracting agency, the Contractor shall request each employment agency, labor union, or authorized representative of workers with which it has a collective bargaining or other agreement or understanding, to furnish a written statement that such employment agency, labor union or representative will not discriminate on the basis of race, creed, color, national origin, sex, age, disability or marital status and that such union or representative will affirmatively cooperate in the implementation of the Contractor's obligations herein; and

(c) the Contractor shall state, in all solicitations or advertisements for employees, that, in the performance of the State contract, all qualified applicants will be afforded equal employment opportunities without discrimination because of race, creed, color, national origin, sex, age, disability or marital status.

Contractor will include the provisions of "(a), (b) and (c)" above, in every subcontract over \$25,000.00 for the construction, demolition, replacement, major repair, renovation, planning or design of real property and improvements thereon (the "Work") except where the Work is for the beneficial use of the Contractor. Section 312 does not apply to: (i) work, goods or services unrelated to this contract; or (ii) employment outside New York State. The State shall consider compliance by a contractor or subcontractor with the requirements of any federal law concerning equal employment opportunity which effectuates the purpose of this clause. The contracting agency shall determine whether the imposition of the requirements of the provisions hereof duplicate or conflict with any such federal law and if such duplication or conflict exists, the contracting agency shall waive the applicability of Section 312 to the extent of such duplication or conflict. Contractor will comply with all duly promulgated and lawful rules and regulations of the Department of Economic Development's Division of Minority and Women's Business Development pertaining hereto.

**13. CONFLICTING TERMS.** In the event of a conflict between the terms of the contract (including any and all attachments thereto and amendments thereof) and the terms of this Appendix A, the terms of this Appendix A shall control.

**14. GOVERNING LAW.** This contract shall be governed by the laws of the State of New York except where the Federal supremacy clause requires otherwise.



**15. LATE PAYMENT.** Timeliness of payment and any interest to be paid to Contractor for late payment shall be governed by Article 11-A of the State Finance Law to the extent required by law.

**16. NO ARBITRATION.** Disputes involving this contract, including the breach or alleged breach thereof, may not be submitted to binding arbitration (except where statutorily authorized), but must, instead, be heard in a court of competent jurisdiction of the State of New York.

**17. SERVICE OF PROCESS.** In addition to the methods of service allowed by the State Civil Practice Law & Rules ("CPLR"), Contractor hereby consents to service of process upon it by registered or certified mail, return receipt requested. Service hereunder shall be complete upon Contractor's actual receipt of process or upon the State's receipt of the return thereof by the United States Postal Service as refused or undeliverable. Contractor must promptly notify the State, in writing, of each and every change of address to which service of process can be made. Service by the State to the last known address shall be sufficient. Contractor will have thirty (30) calendar days after service hereunder is complete in which to respond.

**18. PROHIBITION ON PURCHASE OF TROPICAL HARDWOODS.** The Contractor certifies and warrants that all wood products to be used under this contract award will be in accordance with, but not limited to, the specifications and provisions of Section 165 of the State Finance Law, (Use of Tropical Hardwoods) which prohibits purchase and use of tropical hardwoods, unless specifically exempted, by the State or any governmental agency or political subdivision or public benefit corporation. Qualification for an exemption under this law will be the responsibility of the contractor to establish to meet with the approval of the State.

In addition, when any portion of this contract involving the use of woods, whether supply or installation, is to be performed by any subcontractor, the prime Contractor will indicate and certify in the submitted bid proposal that the subcontractor has been informed and is in compliance with specifications and provisions regarding use of tropical hardwoods as detailed in § 165 State Finance Law. Any such use must meet with the approval of the State; otherwise, the bid may not be considered responsive. Under bidder certifications, proof of qualification for exemption will be the responsibility of the Contractor to meet with the approval of the State.

**19. MACBRIDE FAIR EMPLOYMENT PRINCIPLES.** In accordance with the MacBride Fair Employment Principles (Chapter 807 of the Laws of 1992), the Contractor hereby stipulates that the Contractor

either (a) has no business operations in Northern Ireland, or (b) shall take lawful steps in good faith to conduct any business operations in Northern Ireland in accordance with the MacBride Fair Employment Principles (as described in Section 165 of the New York State Finance Law), and shall permit independent monitoring of compliance with such principles.

**20. OMNIBUS PROCUREMENT ACT OF 1992.** It is the policy of New York State to maximize opportunities for the participation of New York State business enterprises, including minority- and women-owned business enterprises as bidders, subcontractors and suppliers on its procurement contracts.

Information on the availability of New York State subcontractors and suppliers is available from:

NYS Department of Economic Development  
Division for Small Business and Technology Development  
625 Broadway  
Albany, New York 12245  
Telephone: 518-292-5100

A directory of certified minority- and women-owned business enterprises is available from:

NYS Department of Economic Development  
Division of Minority and Women's Business Development  
633 Third Avenue 33rd Floor  
New York, NY 10017  
646-846-7364  
email: [mwbebusinessdev@esd.ny.gov](mailto:mwbebusinessdev@esd.ny.gov)  
<https://ny.newnycontracts.com/FrontEnd/searchcertifiedirectory.asp>

The Omnibus Procurement Act of 1992 (Chapter 844 of the Laws of 1992, codified in State Finance Law § 139-i and Public Authorities Law § 2879(3)(n)-(p)) requires that by signing this bid proposal or contract, as applicable, Contractors certify that whenever the total bid amount is greater than \$1 million:

(a) The Contractor has made reasonable efforts to encourage the participation of New York State Business Enterprises as suppliers and subcontractors, including certified minority- and women-owned business enterprises, on this project, and has retained the documentation of these efforts to be provided upon request to the State;

(b) The Contractor has complied with the Federal Equal Opportunity Act of 1972 (P.L. 92-261), as amended;

(c) The Contractor agrees to make reasonable efforts to provide notification to New York State residents of employment opportunities on this project through listing any such positions with the Job Service Division of the New York State Department of Labor, or providing such notification in such manner as is consistent with existing collective bargaining contracts or agreements. The Contractor agrees to document these efforts and to provide said documentation to the State upon request; and

(d) The Contractor acknowledges notice that the State may seek to obtain offset credits from foreign countries as a result of this contract and agrees to cooperate with the State in these efforts.

**21. RECIPROCITY AND SANCTIONS PROVISIONS.** Bidders are hereby notified that if their principal place of business is located in a country, nation, province, state or political subdivision that penalizes New York State vendors, and if the goods or services they offer will be substantially produced or performed outside New York State, the Omnibus Procurement Act 1994 and 2000 amendments (Chapter 684 and Chapter 383, respectively, codified in State Finance Law § 165(6) and Public Authorities Law § 2879(5)) require that they be denied contracts which they would otherwise obtain. NOTE: As of May 2023, the list of discriminatory jurisdictions subject to this provision includes the states of South Carolina, Alaska, West Virginia, Wyoming, Louisiana and Hawaii.

**22. COMPLIANCE WITH BREACH NOTIFICATION AND DATA SECURITY LAWS.** Contractor shall comply with the provisions of the New York State Information Security Breach and Notification Act (General Business Law §§ 899-aa and 899-bb and State Technology Law § 208).

**23. COMPLIANCE WITH CONSULTANT DISCLOSURE LAW.** If this is a contract for consulting services, defined for purposes of this requirement to include analysis, evaluation, research, training, data processing, computer programming, engineering, environmental, health, and mental health services, accounting, auditing, paralegal, legal or similar services, then, in accordance with Section 163 (4)(g) of the State Finance Law (as amended by Chapter 10 of the Laws of 2006), the Contractor shall timely, accurately and properly comply with the requirement to submit an annual employment report for the contract to the agency that awarded the contract, the Department of Civil Service and the State Comptroller.

**24. PROCUREMENT LOBBYING.** To the extent this agreement is a “procurement contract” as defined by State Finance Law §§ 139-j and 139-k, by signing this

agreement the contractor certifies and affirms that all disclosures made in accordance with State Finance Law §§ 139-j and 139-k are complete, true and accurate. In the event such certification is found to be intentionally false or intentionally incomplete, the State may terminate the agreement by providing written notification to the Contractor in accordance with the terms of the agreement.

**25. CERTIFICATION OF REGISTRATION TO COLLECT SALES AND COMPENSATING USE TAX BY CERTAIN STATE CONTRACTORS, AFFILIATES AND SUBCONTRACTORS.**

To the extent this agreement is a contract as defined by Tax Law § 5-a, if the contractor fails to make the certification required by Tax Law § 5-a or if during the term of the contract, the Department of Taxation and Finance or the covered agency, as defined by Tax Law § 5-a, discovers that the certification, made under penalty of perjury, is false, then such failure to file or false certification shall be a material breach of this contract and this contract may be terminated, by providing written notification to the Contractor in accordance with the terms of the agreement, if the covered agency determines that such action is in the best interest of the State.

**26. IRAN DIVESTMENT ACT.** By entering into this Agreement, Contractor certifies in accordance with State Finance Law § 165-a that it is not on the “Entities Determined to be Non-Responsive Bidders/Offerers pursuant to the New York State Iran Divestment Act of 2012” (“Prohibited Entities List”) posted at: <https://ogs.ny.gov/iran-divestment-act-2012>

Contractor further certifies that it will not utilize on this Contract any subcontractor that is identified on the Prohibited Entities List. Contractor agrees that should it seek to renew or extend this Contract, it must provide the same certification at the time the Contract is renewed or extended. Contractor also agrees that any proposed Assignee of this Contract will be required to certify that it is not on the Prohibited Entities List before the contract assignment will be approved by the State.

During the term of the Contract, should the state agency receive information that a person (as defined in State Finance Law § 165-a) is in violation of the above-referenced certifications, the state agency will review such information and offer the person an opportunity to respond. If the person fails to demonstrate that it has ceased its engagement in the investment activity which is in violation of the Act within 90 days after the determination of such violation, then the state agency shall take such action as may be appropriate and provided for by law, rule, or contract, including, but not limited to, imposing sanctions, seeking compliance, recovering damages, or declaring the Contractor in default.

The state agency reserves the right to reject any bid, request for assignment, renewal or extension for an entity that appears on the Prohibited Entities List prior to the award, assignment, renewal or extension of a contract, and to pursue a responsibility review with respect to any entity that is awarded a contract and appears on the Prohibited Entities list after contract award.

**27. ADMISSIBILITY OF REPRODUCTION OF CONTRACT.** Notwithstanding the best evidence rule or any other legal principle or rule of evidence to the contrary, the Contractor acknowledges and agrees that it waives any and all objections to the admissibility into evidence at any court proceeding or to the use at any examination before trial of an electronic reproduction of this contract, in the form approved by the State Comptroller, if such approval was required, regardless of whether the original of said contract is in existence.

1. If the Contractor performs the Contract, the Surety and the Contractor shall have no obligation under the Performance Bond.

2. The Surety's obligation under this Bond shall arise after:

2.1 The State has notified the Contractor and the Surety in writing that the State is considering declaring a Contractor in default, or

2.2 The State has declared a Contractor in default and formally terminated the Contractor's right to complete the Contract, and

2.3 The State has agreed to pay the Balance of the Contract Price to the Surety or to a Contractor selected to complete the Contract in accordance with the terms of the Contract with the State.

3. The Surety shall promptly and at its own expense, take the following actions:

3.1 Undertake to perform and complete the Contract, through its agent or retained contractor; according to the following schedule:

Day 1-10 Immediately begins its investigation  
Advises OGS of its Representatives.

Day 10-25 Visits Site with OGS representatives to review the contract documents and completed work; and determines extent of acceptable Work.

Day 25-30 Submits proposed completion contractor, completion plan, and CPM as required, for approval by the Office of General Services.

Day 30-44 As completing contractor, the surety or its representative, presents its list of subcontractors to OGS for approval. Additionally an Insurance Certificate naming the Surety and completion Contractor as named insured must be submitted to the Contracting Officer prior to the beginning any completion of the Work. The completion plan and schedule is returned to Surety.

Day 45 Surety begins the Completion of the Work.

4. If the Surety does not proceed with reasonable promptness, the Surety shall be deemed to be in default on the Bond, and the State shall be entitled to enforce any remedy available pursuant to the terms of the contract.

5. After the State has terminated the Contractor's right to complete the Contract, and if the Surety elects to act then the responsibilities of the Surety to the State shall not be greater than those of the Contractor under the Contract, and the responsibilities of the State to the Surety shall not be greater than those provided under the Contract. To the limit of the amount of this Bond, the Surety is obligated to correct defective work and complete the work of the Contract in a timely manner.

6. The penal sum of the Performance Bond furnished by the contractor to the State, approved and filed with the Office of the State Comptroller, in no way shall be impaired or affected by any other bond that may relate to the contract in question.

**END OF DOCUMENT**

DOCUMENT 003126 - EXISTING HAZARDOUS MATERIAL INFORMATION

1.1 EXISTING HAZARDOUS MATERIAL INFORMATION

- A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information, but are not a warranty of existing conditions. This Document and its attachments are not part of the Contract Documents.
- B. A Limited Hazardous Materials Survey for the Project, prepared by Atlantic Testing Laboratories, Ltd, dated March 15, 2021, is appended to this Document.

END OF DOCUMENT 003126

**LIMITED HAZARDOUS MATERIALS SURVEY**

**RYE DEPARTMENT OF PUBLIC WORKS  
RYE, NEW YORK**



**PREPARED BY:**

**ATLANTIC TESTING LABORATORIES, LIMITED  
251 Upper North Road  
Highland, New York 12528**

**PREPARED FOR:**

**Stantec Consulting Services, Inc.  
55 Church Street  
New Haven, Connecticut 06510**

**ATL REPORT NO. PT5465CE-01-03-21**

**March 15, 2021**

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## **1.0 INTRODUCTION**

### **1.1 Purpose**

Atlantic Testing Laboratories, Limited (ATL) was retained by Stantec Consulting Services, Inc. to perform a limited hazardous materials survey of designated areas within the Rye Department of Public Works (DPW) Maintenance Garage, attached apartment, and “L–Building”. The survey was performed on February 4 and 5, 2021. The purpose of the limited hazardous materials survey was to identify asbestos-containing materials (ACM), lead-containing paint, and polychlorinated biphenyls (PCB)-containing caulk/sealant that are present on exposed surfaces within the subject areas, and may have a significant impact on planned demolition activities. The project also included the inventory/identification of other miscellaneous suspect hazardous materials-containing items commonly encountered in buildings. The limited hazardous materials survey procedures and report format that follow are in general compliance with applicable local, state, and federal rules and regulations.

### **1.2 Project Team and Certifications**

Members of the ATL project team included Cameron Heller, Project Manager; and Devin Bianco, Environmental Specialist. Certifications of ATL's field survey team members and a copy of applicable company licenses maintained by ATL are included in Appendix A.

## **2.0 SCOPE OF WORK**

### **2.1 Project Description**

The project site is located at 141 Oakland Beach Avenue, Rye, Westchester County, New York.

The intent of the limited hazardous materials survey was to identify suspect ACM, lead-containing paint, and PCB-containing caulk/sealant that are located within designated areas of the DPW Maintenance Garage, attached apartment, and “L–Building”, and may be impacted during a proposed demolition project. Other miscellaneous suspect hazardous materials-containing items were also identified as described herein.

The limited hazardous materials survey was conducted for the subject areas, as directed by Jeff Olszewski, representing Stantec Consulting Services, Inc. The subject areas were occupied and operational at the time of the sampling event.

### **2.2 Inaccessible Areas**

The extent of inaccessible areas is dependent upon the building type, construction materials, history of renovations and repairs, and project scope. Concealed materials may exist in areas that are not readily exposed to view. Although this limited hazardous materials survey was performed to identify suspect hazardous materials-containing items within the subject areas, potential hazardous materials-containing items may have escaped detection that could be encountered during future building demolition and/or renovation activities. Wall, ceiling, floor, roofing, and/or other component systems may contain concealed suspect hazardous materials. If any suspect hazardous materials are encountered during demolition and/or renovation activities, the activities disturbing the suspect hazardous materials must stop and the material must be sampled and laboratory analyzed or otherwise managed in accordance with applicable regulations.



The roof areas for the DPW Maintenance Garage and attached apartment weren't accessed for sampling. Suspect ACM associated with this roof will need to be assumed ACM.

### **2.3 Document Review**

No historical hazardous materials survey reports or sampling and analysis data were available for review at the time of the limited hazardous materials survey.

### **2.4 Limitations**

This report has been prepared in accordance with the scope of work outlined in ATL's contract (ATL No. PT5998-485X-07-18) and should not be used as abatement specifications or design documents. The findings, conclusions, and recommendations presented in this report are based on the field observations made by representatives of ATL and the information provided by representatives of Stantec Consulting Services, Inc.

Quantities and locations of sampled materials are approximate, and should be verified by the abatement contractor(s) prior to providing actual cost quotations and/or initiating abatement activities. Variations in reported quantities and locations for sampled materials, in addition to the discovery of suspect materials not identified in this report, is possible due to the presence of inaccessible areas, as described in Section 2.2 of this report.

The findings and opinions are relevant to the dates of our site work and should not be relied on to represent conditions at substantially later dates.

## **3.0 ASBESTOS**

### **3.1 Methodology**

A visual examination of the subject areas was conducted by an Asbestos Building Inspector to identify suspect ACM. Functional spaces were identified to assist while locating suspect ACM. A functional space is defined as a spatially distinct area within a building that contains identifiable populations of building occupants. A functional space may include a room, a group of rooms, or other defined area, and several functional spaces may comprise a single homogeneous sampling area. A homogeneous sampling area is defined as an area that is uniform by color, texture, construction/application, and general appearance. Each identified functional space was visually examined to determine the locations of suspect ACM. These materials were then delineated into homogeneous sampling areas.

Samples of each accessible homogeneous area were collected and placed in clean, labeled containers. The appropriate custody documentation was completed and the suspect ACM samples were submitted to AmeriSci New York (AmeriSci), located in New York, New York. The samples were laboratory analyzed by polarized light microscopy (PLM) and transmission electron microscopy (TEM) methodologies, as applicable. AmeriSci is a New York State Department of Health (NYSDOH) certified laboratory for PLM and TEM analysis under Environmental Laboratory Approval Program (ELAP) No. 11480. AmeriSci is also accredited by the National Institute of Standards and Technology (NIST), under the National Voluntary Laboratory Accreditation Program (NVLAP).

### 3.2 Regulatory Compliance

In New York State, there are multiple regulatory agencies that have jurisdiction over ACM in buildings. Asbestos survey requirements are primarily regulated or specified by the New York State Department of Labor (NYSDOL), the New York State Department of Health (NYSDOH), the Occupational Safety and Health Administration (OSHA), and the United States Environmental Protection Agency (EPA).

The NYSDOL established Part 56 of The Official Compilation of Codes, Rules, and Regulations (cited as 12 NYCRR, Part 56) to address the proper identification, handling, removal, and disposal of ACM in buildings. Asbestos survey requirements are specified in Subpart 56-5.1 "Asbestos Survey Requirements for Building/Structure Demolition, Renovation, Remodeling and Repair." The NYSDOL also works in conjunction with the NYSDOH to establish and maintain asbestos safety training program requirements, and enforce personnel certifications and licensing protocol for asbestos contractors.

The OSHA defines requirements for asbestos surveys and identification of ACM and presumed asbestos-containing materials (PACM) in 29 CFR 1926.1101 (k) "Communication of Hazards." Under this regulation, OSHA makes reference to conducting inspections according to 1926.1101 (k)(5)(ii)(B) and 1926.1101 (k)(5)(iii) or pursuant to the requirements of the Asbestos Hazard Emergency Response Act (AHERA) 40 CFR Part 763, Subpart E "Asbestos-Containing Materials in Schools." The AHERA is regulated by the EPA, and applies to primary and secondary schools only; however, the procedures mandated under AHERA are generally considered the industry standards for surveys, as these are typically the most stringent.

### 3.3 Summary of Findings

A total of 55 homogeneous areas of suspect ACM were identified during the visual examination, from which 125 bulk samples were collected and subsequently submitted to a NYSDOH approved laboratory for analysis. Approximate sample locations are depicted on the Sample Location Plans, contained in Appendix B. A copy of laboratory reports and sample custody documentation are contained in Appendix C. Table D-I contained in Appendix D, provides a summary of the identified suspect ACM and associated analytical results.

The EPA, NYSDOL, and other regulatory agencies define ACM as any material containing greater than 1% of asbestos. Materials listed in bold font in Table D-I of Appendix D were determined or assumed to be ACM.

Materials containing trace asbestos (i.e., less than 1%) are not considered ACM; however, the OSHA recognizes materials that contain trace amounts of asbestos, and requires these materials be handled in accordance with their standard interpretation letter titled "Requirements for demolition operations involving material containing <1% asbestos", dated August 13, 1999. As shown in Table D-I of Appendix D, 2 materials were determined to contain trace amounts of asbestos.

Other materials that were observed, but are not considered suspect ACM, include the following;

• Glass	• Nylon-Coated Wire Jacket
• Wood	• Metal
• Ceramic Tile	• Doors

## **4.0 LEAD-CONTAINING PAINT**

### **4.1 Methodology**

A visual examination of the subject areas was conducted by a Lead Inspector to identify potential lead-containing paint. Functional spaces were identified as described in Section 3.1 of this report, to assist locating suspect lead-containing paint. Potential lead-containing paint surfaces were classified into homogeneous areas. A homogeneous area is defined as similar paint color schemes, building components, and substrates the paint is applied on.

A visual examination of the subject building was conducted by a Lead Inspector to identify visible and accessible painted surfaces. The painted surfaces were categorized into homogeneous areas from which tests could be conducted. Each homogeneous area was tested using a Heuresis Pb200i XRF Analyzer. This equipment provides instantaneous measurements for lead concentration in mg/cm<sup>2</sup>, and displays readings that are positive or negative indications for lead-containing paint. Calibration checks for the XRF equipment were performed in accordance with the manufacturer's recommendations.

### **4.2 Regulatory Compliance**

Although New York State has established Title X, Part 67 of The Official Compilation of Codes, Rules, and Regulations (cited as NYCRR Title X, Part 67) for "Lead Poisoning Prevention and Control," lead-based paint (LBP) inspections and risk assessments are generally subject to the requirements of federal regulations. The United States Department of Housing and Urban Development (HUD), EPA, and OSHA are the primary federal regulatory agencies responsible for the establishment and enforcement of such regulations. On a state level, the NYSDOH does require laboratories to be certified to perform lead analysis under the ELAP.

The HUD "Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing" include details pertaining to sampling and analysis of suspect LBP, in addition to the identification and control of LBP hazards. The HUD guidelines pertain to federally owned or assisted housing; however, these are commonly referenced and made mandatory by other regulatory agencies. The EPA requirements for LBP activities, specified in 40 CFR Part 745, apply to targeted housing and child-occupied facilities, and are similar to HUD guideline requirements.

The OSHA Construction Standard for Lead (29 CFR 1926.62) applies to employees of an employer who may or will be exposed to occupational levels of lead. OSHA requires employees to maintain, at a minimum, awareness, respiratory protection, and hazard communication training.

### **4.3 Summary of Findings**

A total of 208 locations were tested using the XRF spectrometer. Approximate sample locations are depicted on the Sample Location Plans, contained in Appendix B. A summary of the XRF results and calibration checks are provided in Appendix E. The XRF results provided in Table E-I of Appendix E represent painted surfaces that were determined to be LBP, per HUD criteria. Table E-II of Appendix E identifies painted surfaces that contain detectable concentrations of lead, but are not considered LBP, as compared to HUD criteria. Painted surfaces that did not contain lead at a concentration above the method detection limits are summarized in Table E-III of Appendix E. Calibration checks for the XRF spectrometer are provided in Table E-IV of Appendix E.

## **5.0 POLYCHLORINATED BIPHENYLS**

### **5.1 Methodology**

A visual examination of the subject areas was conducted by an Environmental Scientist to identify suspect PCB-containing caulk/sealant. The identified materials were classified into homogeneous sampling areas. A homogeneous sampling area is defined as an area that is uniform by color, texture, construction/application, and general appearance.

Samples of each accessible homogeneous area were collected and placed in clean, labeled containers. The appropriate custody documentation was completed and the suspect PCB-containing caulk samples were submitted to Alpha Analytical, located in Westborough, Massachusetts (11148). The samples were laboratory analyzed for PCB, in accordance with EPA Method 8082.

### **5.2 Regulatory Compliance**

PCB are primarily regulated by the EPA. The EPA has issued several documents and enforces federal mandated laws and regulations governing the usage, management, and disposal of PCB-containing materials. State and local regulatory agencies have also enacted laws and regulations concerning PCB materials, many of which are consistent with the regulations set forth by the EPA. In accordance with the regulations and guidelines presented in 40 CFR Parts 750 and 761 "Disposal of Polychlorinated Biphenyls; Final Rule," PCB wastes are generally regulated for disposal under the Toxic Substances Control Act (TSCA) if the concentrations are 50 ppm or greater. Per New York State Department of Environmental Conservation (NYSDEC) regulations, material containing PCB at 50 ppm or greater is regulated hazardous waste.

### **5.3 Summary of Findings**

A total of 5 homogeneous suspect PCB-containing caulk materials were identified during the visual examination, from which 5 bulk samples were collected and subsequently submitted to a NYSDOH approved laboratory for analysis. Approximate sample locations are depicted on the Sample Location Plans, contained in Appendix B. A copy of laboratory reports and associated sample custody documentation are contained in Appendix C. Table D-II, of Appendix D, provides a summary of the identified suspect PCB-containing caulk and associated analytical results.

PCB-containing caulk is regulated under the TSCA as an "unauthorized use," and is considered a regulated hazardous material at concentrations equal to or greater than 50 ppm. None of the samples collected contained total PCB at a concentration of 50 ppm or greater.

## **6.0 MISCELLANEOUS ITEMS**

### **6.1 Methodology**

In addition to suspect ACM, lead-containing paint, and PCB-containing caulk/sealants, the hazardous materials survey included an inventory/identification of other miscellaneous potential hazardous materials-containing items observed within designated areas of the subject structures. This inventory/identification was performed to identify suspect hazardous materials-containing items commonly encountered within buildings or structures that may have a significant impact on future site management activities. As such, the inventory/identification of

miscellaneous potential hazardous materials-containing items included observations of exposed and readily accessible items and is not intended to represent an exhaustive assessment.

A visual reconnaissance of the subject structures and components that were readily observable was conducted by the field survey team. Subsequent to identifying suspect hazardous materials or items suspected of containing hazardous materials, labels and material identification data was accessed, to the extent that was reasonably and safely possible, in an attempt to verify the presence or absence of hazardous materials.

## **6.2 Suspect Hazardous Materials-Containing Items**

### **6.2.1 Light Ballasts**

Fluorescent light ballasts were observed within the subject structures. Prior to a ban on the manufacture of PCB by the EPA in 1978, fluorescent light ballasts from this time period commonly contained PCB. Table D-III, contained in Appendix D, provides a summary of the identified fluorescent light ballasts within the designated areas of the subject structures.

### **6.2.2 Fluorescent and High Pressure Sodium Lamps**

Fluorescent lamps and high pressure sodium lamps associated with light fixtures are located within the subject structures. Mercury is a constituent of fluorescent lamps and high pressure sodium lamps. Table D-III, contained in Appendix D, provides a summary of the identified fluorescent and high pressure sodium lamps within the designated areas.

## **7.0 CONCLUSIONS AND RECOMMENDATIONS**

The following conclusions and recommendations are prepared from ATL's understanding that the subject buildings may be subject to demolition projects. Should the management of the building areas change, it is recommended that the findings be revisited to reflect appropriate operations and management practices for hazardous materials containing items.

### **7.1 General**

1. Concealed regulated hazardous materials may exist at the site that could be encountered during future building demolition activities. Wall, ceiling, floor, roofing, and/or other component systems may contain concealed suspect hazardous materials. If any suspect hazardous materials or hazardous materials-containing items are encountered during demolition and/or renovation activities, the activities disturbing the suspect material must stop and the material must be sampled and laboratory analyzed or otherwise managed pursuant to in accordance with applicable regulations.

### **7.2 Asbestos-Containing Materials**

1. The materials listed in bold in Table D-I of Appendix D were determined to be ACM. The referenced table also shows materials that contain trace concentrations of asbestos and are regulated under OSHA.
2. Subpart 56-5(h) of 12 NYCRR Part 56 requires that no demolition, renovation, remodeling, or repair work be commenced by any owner or the owner's agent prior to the completion of asbestos abatement. Asbestos abatement must be performed by an asbestos abatement contractor that maintains a current asbestos handling license, and employs NYSDOL

certified asbestos handlers and supervisors. It is recommended that a 12 NYCRR 56 certified Project Monitor oversee abatement activities.

3. Subpart 56-5(g) of 12 NYCRR Part 56 specifies requirements for transmittal of asbestos survey information by the owner or owner's agent. One copy of the asbestos survey report shall be sent to the local government entity charged with issuing a permit for such demolition, renovation, remodeling, or repair work under applicable State or local laws. If controlled demolition or pre-demolition activities will be performed, one copy of the asbestos survey report shall be submitted to the appropriate Asbestos Control Bureau district office. One copy of the asbestos survey report must be kept on the construction site throughout the duration of the asbestos project and any associated demolition, renovation, remodeling, or repair project.

### **7.3 Lead-Containing Paint**

1. The materials listed in Table E-I of Appendix E were determined to be LBP per HUD criteria. Table E-II of Appendix E lists materials that are not considered LBP per HUD criteria, but contain detectable concentrations of lead and are regulated under OSHA.
2. Identified LBP with a detectable concentration of lead should be managed in accordance with applicable EPA and OSHA requirements prior to or during demolition, renovation, remodeling, or repair work.
3. Demolition/renovation contractors are required to conduct exposure monitoring or use historical objective data to ensure that employee exposures do not exceed the action level of 30  $\mu\text{g}/\text{m}^3$ .

### **7.4 PCB-Containing Materials**

1. None of the caulk materials sampled contained PCB concentrations equal to or exceeding 50 ppm, and are therefore not considered hazardous materials/hazardous waste.
2. The EPA considers caulk with a PCB concentration greater than or equal to 50 ppm as an "unauthorized use", and requires that these materials be properly removed and disposed of. Materials that contain PCB concentration less than 50 ppm also typically have specific handling, management, and disposal criteria to limit exposure and environmental impacts.

### **7.5 Miscellaneous Items**

It is recommended that the hazardous materials or suspect hazardous materials-containing items summarized in Section 6.2 of this report be managed and/or disposed of in accordance with local, state, and federal requirements. With the exception of banned materials or items containing banned materials, the most effective management option for materials and items that are in good condition and not susceptible to a release of hazardous substances to the environment is reuse. If reuse is not applicable, alternative management, recycling, or disposal options would need to be selected to ensure compliance with applicable local, state, and federal requirements.

### **7.5.1 *Light Ballasts***

1. It is recommended that light ballasts with suspect PCB-containing materials, DEHP, and/or lead solder be managed and/or disposed of in accordance with local, state, and federal requirements.

### **7.5.2 *Fluorescent and High Pressure Sodium Lamps***

1. Mercury-containing lamps should be recycled in accordance with local, state, and federal requirements. A list of lamp recyclers can be obtained from the New York State Department of Environmental Conservation (NYSDEC).

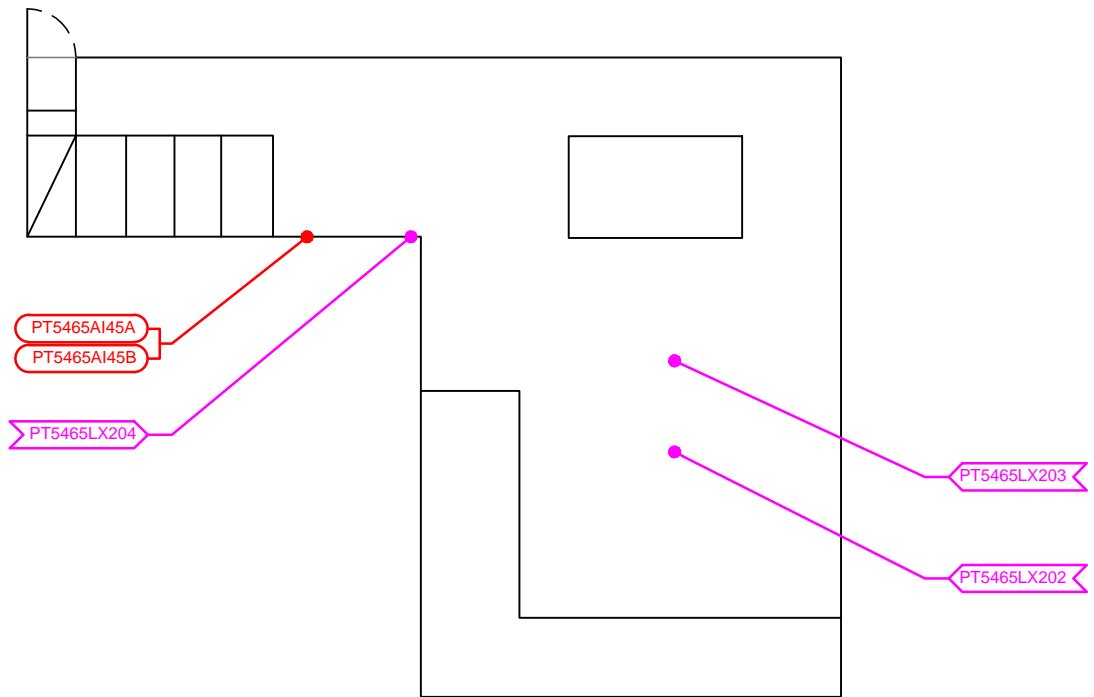
**APPENDIX B**  
**SAMPLE LOCATION PLANS**



Side A

Side D

Side B



Basement Sample Location Plan - Main Garage

Scale: NTS

ACM and Lead

LEGEND :

A

ATL Room Designation for Labeling Purposes

PT5465AI01A

Suspect Asbestos Sample ID and Approximate Location

PT5465LX01

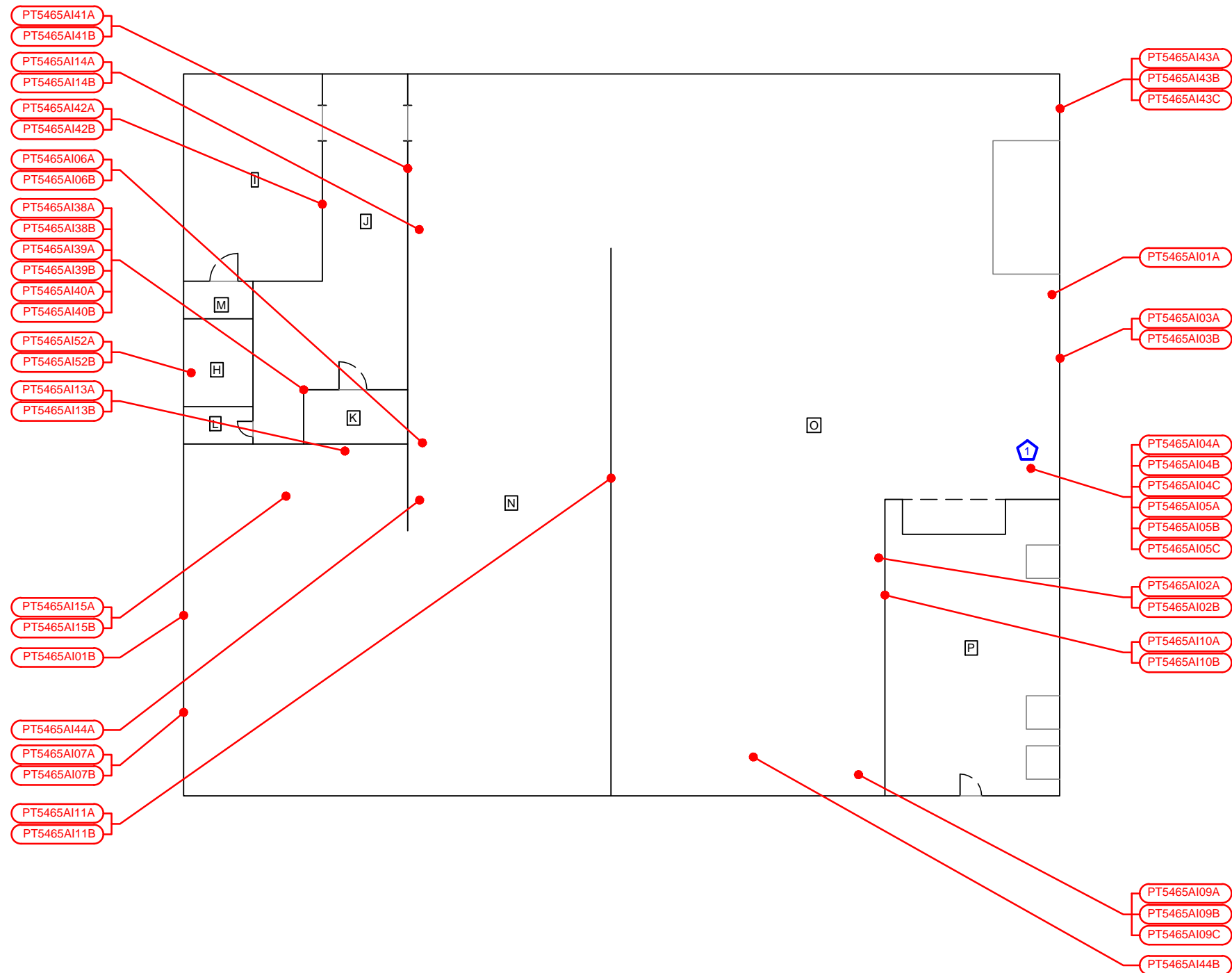
Suspect Lead-Based XRF Sample ID and Approximate Location

Side A

Side Designation for XRF Sampling

Side C

SAMPLE LOCATION PLAN	Drawn By: JDF	Drawing: 1 of 7	Scale: As Noted	Project No.: PT5465	Date : March 2021
Rye - DPW Building Assessment DPW Site Disbrow Park Rye, New York	<div><div>atl</div><div>ATLANTIC TESTING LABORATORIES, Limited</div><div>Albany, NY Binghamton, NY Canton, NY Elmira, NY Poughkeepsie, NY Plattsburgh, NY Rochester, NY Syracuse, NY Utica, NY Watertown, NY</div><div>WBE Certified Companywww.AtlanticTesting.com</div></div>				



# First Floor Sample Location Plan - Main Garage

Scale: NTS

ACM

## LEGEND :



ATL Room Designation for Labeling Purposes



Suspect Asbestos Sample ID and Approximate Location

## ASBESTOS KEY NOTES :



Off-White Pipe TSI and Associated White Pipe TSI Jacket

## SAMPLE LOCATION PLAN

Drawn By:

JDF

Drawing:

2 of 7

Scale:

As Noted

Project No.:

PT5465

Date :

March 2021

Rye - DPW Building Assessment  
DPW Site Disbrow Park  
Rye, New York

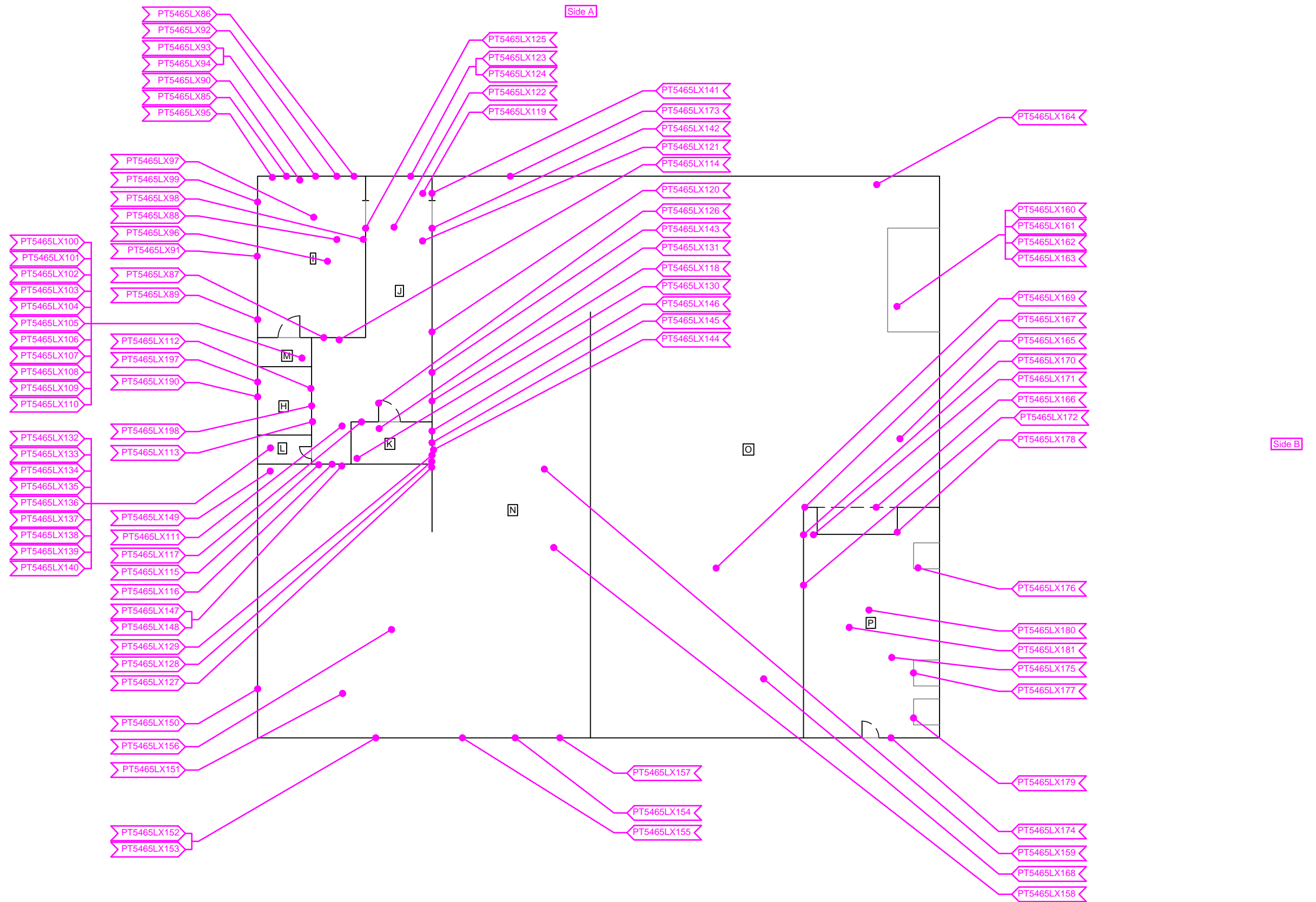


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First Floor Sample Location Plan - Main Garage  
Scale: NTS

Lead

LEGEND :

- [A] ATL Room Designation for Labeling Purposes  
PT5465LX01 Suspect Lead-Based XRF Sample ID and Approximate Location  
[Side A] Side Designation for XRF Sampling

SAMPLE LOCATION PLAN

Rye - DPW Building Assessment  
DPW Site Disbrow Park  
Rye, New York

Drawn By: JDF	Drawing: 3 of 7	Scale: As Noted	Project No.: PT5465	Date : March 2021
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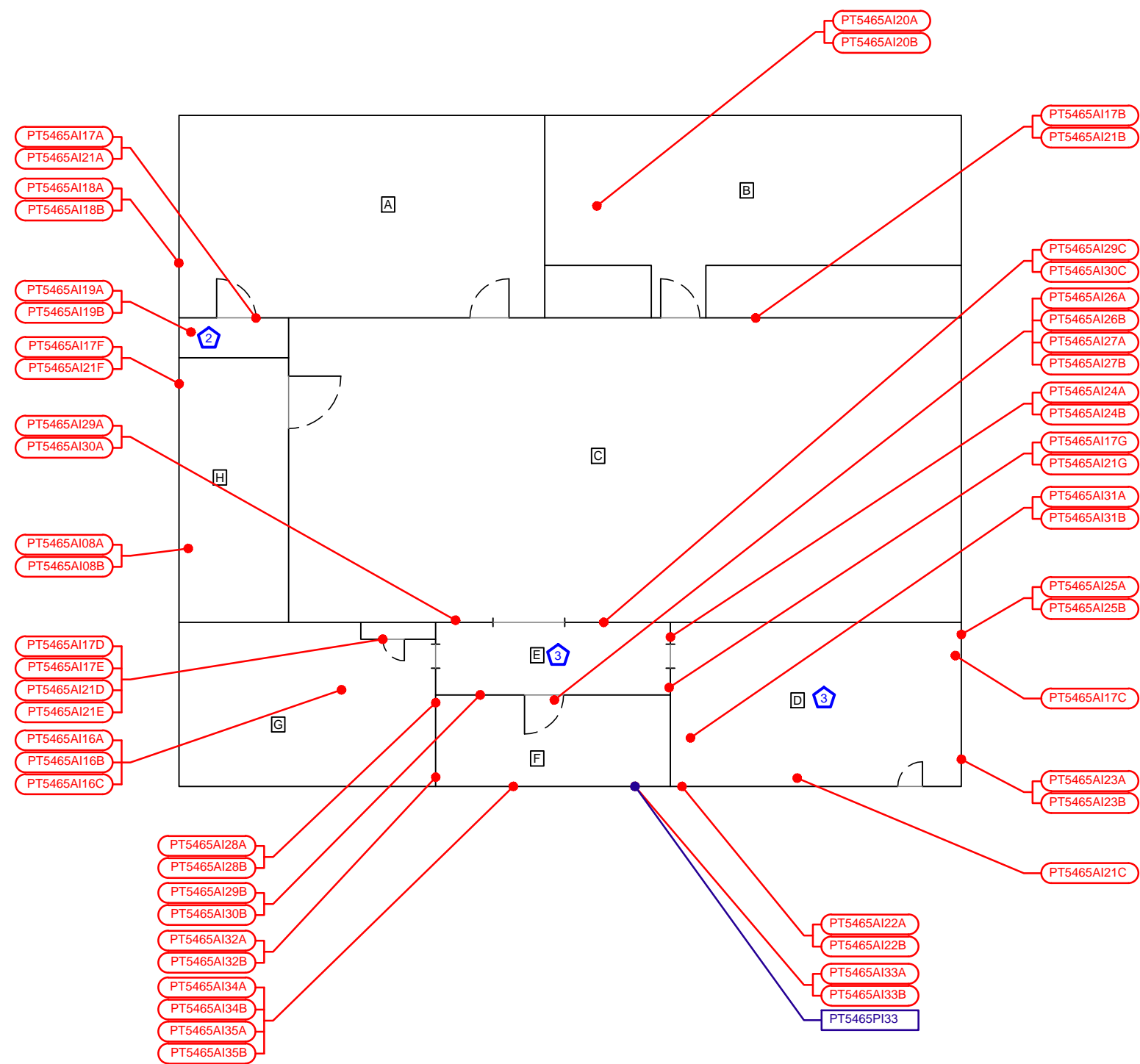


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**LEGEND :**


-  ATL Room Designation for Labeling Purposes
-  Suspect Asbestos Sample ID and Approximate Location
-  Suspect PCB-Containing Caulk Sample ID and Approximate Location

**ASBESTOS KEY NOTES :**

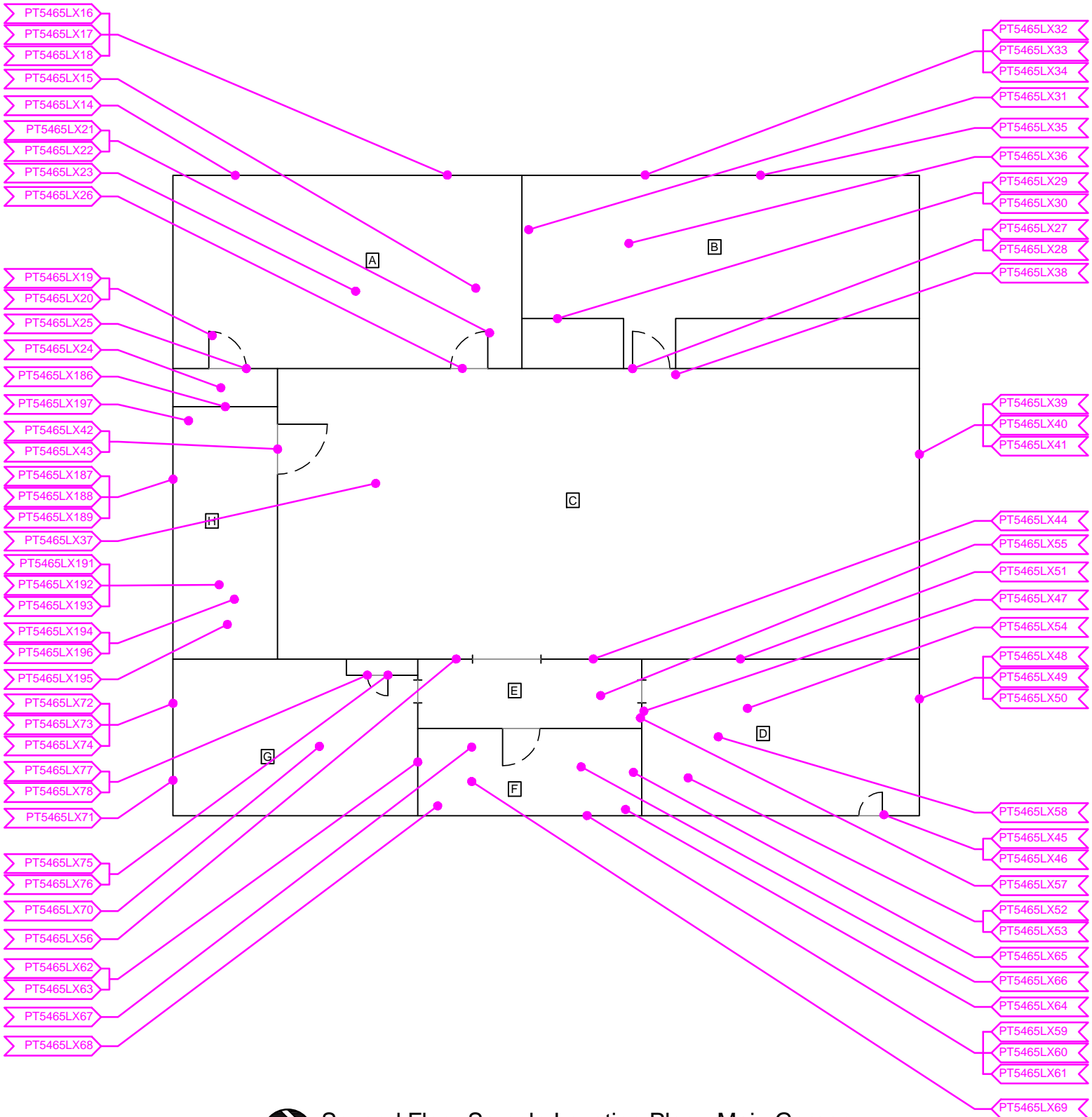
-  White Pattern Linoleum
-  Off-White Pattern Linoleum



**Second Floor Sample Location Plan - Main Garage**  
Scale: NTS  
ACM and PCB

SAMPLE LOCATION PLAN		Drawn By:	Drawing:	Scale:	Project No.:	Date :
		JDF	4 of 7	As Noted	PT5465	March 2021
Rye - DPW Building Assessment DPW Site Disbrow Park Rye, New York		 <b>ATLANTIC TESTING LABORATORIES, Limited</b> Albany, NY Binghamton, NY Canton, NY Elmira, NY Poughkeepsie, NY Plattsburgh, NY Rochester, NY Syracuse, NY Utica, NY Watertown, NY <small>WBE Certified Company www.AtlanticTesting.com</small>				

Side A



Side D

Side B



Second Floor Sample Location Plan - Main Garage  
Scale: NTS  
Lead

Side C

LEGEND :

- [A] ATL Room Designation for Labeling Purposes
- PT5465LX01 Suspect Lead-Based XRF Sample ID and Approximate Location
- Side A Side Designation for XRF Sampling

SAMPLE LOCATION PLAN

Rye - DPW Building Assessment  
DPW Site Disbrow Park  
Rye, New York

Drawn By:  
JDF

Drawing:  
5 of 7

Scale:  
As Noted

Project No.:  
PT5465

Date :  
March 2021



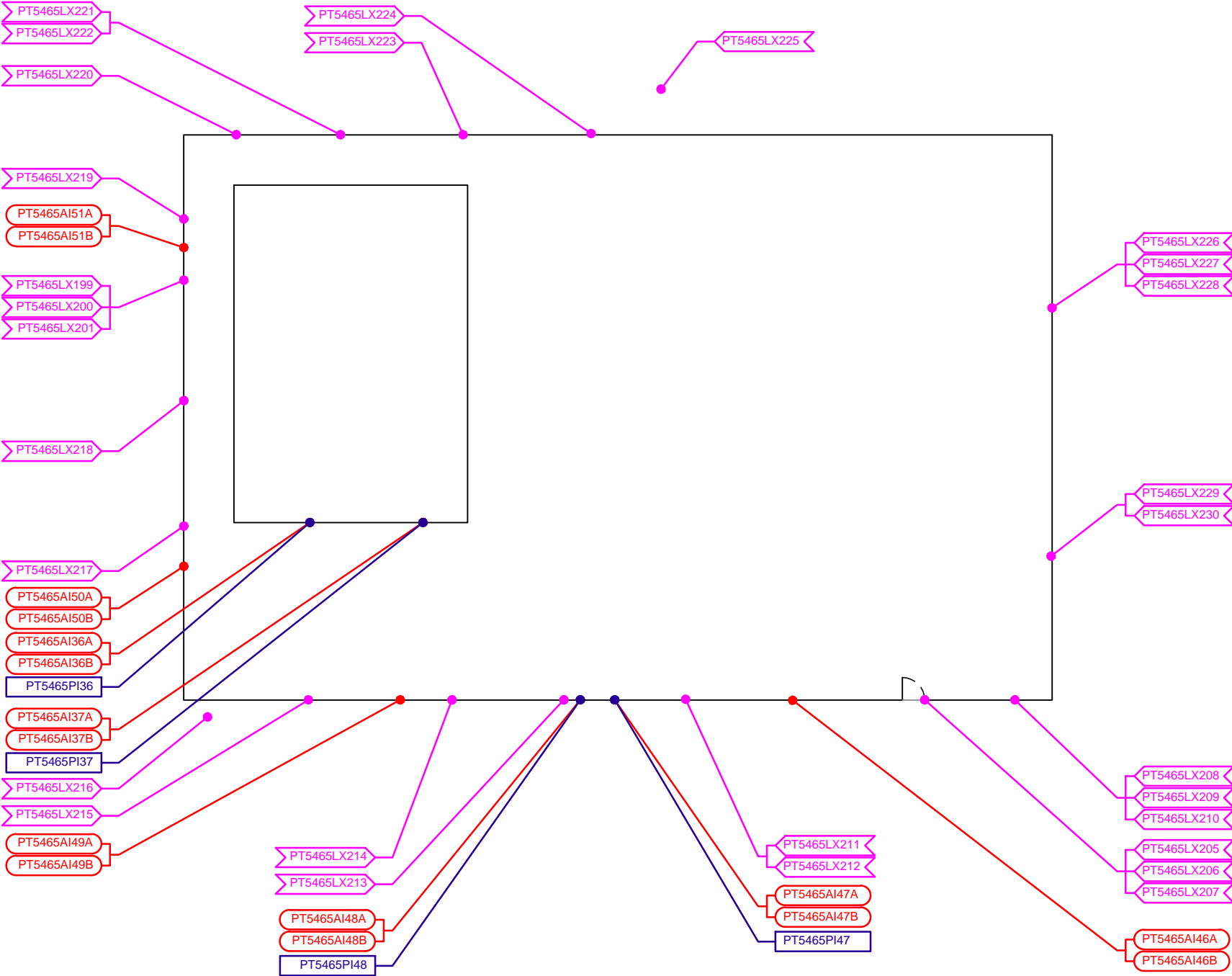
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Side A



Side D

Side B

Side C

LEGEND :

- [A] ATL Room Designation for Labeling Purposes
- PT5465AI01A Suspect Asbestos Sample ID and Approximate Location
- PT5465PI01 Suspect PCB-Containing Caulk Sample ID and Approximate Location
- PT5465LX01 Suspect Lead-Based XRF Sample ID and Approximate Location
- Side A Side Designation for XRF Sampling



Roof/Exterior Sample Location Plan - Main Garage

Scale: NTS

ACM, Lead, and PCB

SAMPLE LOCATION PLAN

Drawn By: JDF	Drawing: 6 of 7	Scale: As Noted	Project No.: PT5465	Date : March 2021
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Rye - DPW Building Assessment  
DPW Site Disbrow Park  
Rye, New York



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**APPENDIX D**  
**SUMMARY TABLES**

## KEY FOR SUMMARY TABLES

### Acronyms for the Known or Assumed ACM:

CFT = Ceramic Floor Tile

CWT = Ceramic Wall Tile

EPDM = Ethylene Propylene Diene Monomer

HVAC = Heating, Ventilation, and Air Conditioning

TSI = Thermal System Insulation

### Abbreviations for Friable/ACM Type:

Y = Yes

N = No

M = Miscellaneous

S = Surfacing

T = Thermal System Insulation

### Descriptions for Conditions:

The listed conditions of Good, Fair, and Poor generally correspond with the AHERA descriptions of Good, Damaged, and Significantly Damaged for different types of materials. The following summarizes additional details relative to the listed conditions.

Surfacing (Surf.) and Miscellaneous (Misc.) Materials

- Good: Material with no visible damage or deterioration, or showing only very limited damage or deterioration
- Fair: Material with characteristics of surface crumbling, blistered, water-stained, gouged, marred, or otherwise abraded over less than one tenth of the surface if the damage is evenly distributed or one quarter if the damage is localized.
- Poor: Material with one or more of the following characteristics:
  - Surface crumbling or blistering is present over at least one tenth of the surface, if the damage is evenly distributed or one quarter if the damage is localized.
  - One tenth (or one quarter, if localized) of material hanging from the surface, deteriorated, or showing adhesive failure.
  - Water stains, gouges, or mars over at least one tenth of the surface if the damage is evenly distributed or one quarter if the damage is localized.

Thermal System Insulation (TSI) Materials

- Good: Material with no visible damage or deterioration, or showing only very limited damage or deterioration
- Fair: Material with one or more of the following characteristics:
  - A few water stains or less than one tenth of insulation with missing jackets.
  - Crushed insulation or water stains, gouges, punctures, or mars on up to one tenth of the insulation if the damage is evenly distributed or up to one quarter if the damage is localized.
- Poor: Material with one or more of the following characteristics:
  - Missing jackets on at least one tenth of the piping or equipment.
  - Crushed or heavily gouged or punctured insulation on at least one tenth of the component (pipe runs/risers, boiler, tank, duct, etc.) if the damage is evenly distributed or one quarter if the damage is localized.

### Notes:

<sup>1</sup> Sample Location Plans are enclosed in Appendix B. Areas of the structure were alphabetically labeled at the time of the survey event.

<sup>2a</sup> NAD = No Asbestos Detected/ <sup>2b</sup> ND = Not detected above the laboratory method detection limit.

<sup>3</sup> Quantities and locations are approximate and must be verified by asbestos abatement contractors prior to providing actual cost quotations and/or initiating abatement activities.

<sup>4</sup> NA = Not Applicable



**Table D-I**  
**Summary of Suspect ACM and Analytical Results**

<b>Material</b>	<b>General Location<sup>1</sup></b>	<b>Friable/ ACM Type</b>	<b>% Asbestos<sup>2A</sup></b>	<b>Condition</b>	<b>Sample Numbers</b>	<b>Estimated Quantity<sup>3, 4</sup></b>
<b>Maintenance Garage and Attached Apartment</b>						
Light Gray Block Mortar	Throughout	N / M	NAD	Fair	PT5465AI01A PT5465AI01B	NA
Gray Pattern Gypsum Ceiling Board	Rooms N, O, and P	N / M	NAD	Fair	PT5465AI02A PT5465AI02B	NA
Light Gray Block Mortar	Room O	N / M	NAD	Fair	PT5465AI03A PT5465AI03B	NA
<b>White Pipe TSI Jacket</b>	<b>Room O – Air Compressor Line</b>	<b>N / T</b>	<b>33.3</b>	<b>Fair</b>	<b>PT5465AI04A PT5465AI04B PT5465AI04C</b>	<b>1 Square Foot</b>
<b>Off-White TSI</b>	<b>Room O – Air Compressor Line</b>	<b>N / M</b>	<b>16.7</b>	<b>Fair</b>	<b>PT5465AI05A PT5465AI05B PT5465AI05C</b>	<b>1 Square Foot</b>
White Gypsum Ceiling Board	Rooms N, O, and P	N / M	NAD	Fair	PT5465AI06A PT5465AI06B	NA
<i>Off-White Window Glazing</i>	<i>Rooms I, N, O, P Windows</i>	<i>N / M</i>	<i>Trace</i>	<i>Fair</i>	<i>PT5465AI07A PT5465AI07B</i>	<i>5 Square Feet</i>
White 1- by 1-Foot Pinhole Ceiling Tile	Room H	Y / M	NAD	Fair	PT5465AI08A PT5465AI08B	NA
Silver HVAC TSI Seam Tape	Room O	N / T	NAD	Fair	PT5465AI09A PT5465AI09B PT5465AI09C	NA
White Joint Compound	Rooms N and O	N / M	NAD	Fair	PT5465AI10A PT5465AI10B	NA
Gray Brick Mortar	Center Wall of Garage	N / M	NAD	Fair	PT5465AI11A PT5465AI11B	NA
Red Refractory Brick	Room N	N / M	NAD	Fair	PT5465AI13A PT5465AI13B	NA
Gray Speed Tile Mortar	Room N	N / M	NAD	Fair	PT5465AI14A PT5465AI14B	NA
Gray Textured Ceiling Plaster	Room N	N / M	NAD	Fair	PT5465AI15A PT5465AI15B	NA

**Table D-I**  
**Summary of Suspect ACM and Analytical Results**

<b>Material</b>	<b>General Location<sup>1</sup></b>	<b>Friable/ ACM Type</b>	<b>% Asbestos<sup>2A</sup></b>	<b>Condition</b>	<b>Sample Numbers</b>	<b>Estimated Quantity<sup>3, 4</sup></b>
White 12- by 12-Inch Smooth Ceiling Tile	Rooms A, B, C, D, and G	Y / M	NAD	Fair	PT5465AI16A PT5465AI16B PT5465AI16C	NA
White Skim Coat Wall Plaster	Rooms A, B, C, D, E, F, G, H, L, and M	Y / S	NAD	Fair	PT5465AI17A PT5465AI17B PT5465AI17C PT5465AI17D PT5465AI17E PT5465AI17F PT5465AI17G	NA
Gray Penetration Caulk	Room A	N / M	NAD	Fair	PT5465AI18A PT5465AI18B	NA
<b>White Pattern Linoleum</b>	<b>Room A Closet</b>	<b>N / M</b>	<b>8.1</b>	<b>Fair</b>	<b>PT5465AI19A PT5465AI19B</b>	<b>3 Square Feet</b>
Off-White Marbled Linoleum	Room B	N / M	NAD	Fair	PT5465AI20A PT5465AI20B	NA
Gray Base Coat Wall Plaster	Rooms A, B, C, D, E, F, G, H, L, and M	N / S	NAD	Fair	PT5465AI21A PT5465AI21B PT5465AI21C PT5465AI21D PT5465AI21E PT5465AI21F PT5465AI21G	NA
Light Gray Pattern Linoleum	Room D	N / M	NAD	Fair	PT5465AI22A PT5465AI22B	NA
Off-White Fibrous Board	Room D	N / M	NAD	Fair	PT5465AI23A PT5465AI23B	NA
Off-White Speckled Linoleum	Room E	N / M	NAD	Fair	PT5465AI24A PT5465AI24B	NA
<b>Off-White Pattern Linoleum</b>	<b>Rooms D and E</b>	<b>N / M</b>	<b>6.4</b>	<b>Fair</b>	<b>PT5465AI25A PT5465AI25B</b>	<b>490 Square Feet</b>
Gray CFT Mortar	Room E	N / M	NAD	Fair	PT5465AI26A PT5465AI26B	NA
Gray CFT Grout	Room E	N / M	NAD	Fair	PT5465AI27A PT5465AI27B	NA

**Table D-I**  
**Summary of Suspect ACM and Analytical Results**

<b>Material</b>	<b>General Location<sup>1</sup></b>	<b>Friable/ ACM Type</b>	<b>% Asbestos<sup>2A</sup></b>	<b>Condition</b>	<b>Sample Numbers</b>	<b>Estimated Quantity<sup>3, 4</sup></b>
Blue Patterned Wallpaper	Room F	N / M	NAD	Fair	PT5465AI28A PT5465AI28B	NA
Gray Base Coat Ceiling Plaster	Rooms E, H, L, and M	N / S	NAD	Fair	PT5465AI29A PT5465AI29B PT5465AI29C	NA
White Skim Coat Ceiling Plaster	Rooms E, H, L, and M	Y / S	NAD	Fair	PT5465AI30A PT5465AI30B PT5465AI30C	NA
Gray Speckled Countertop	Room D	N / M	NAD	Fair	PT5465AI31A PT5465AI31B	NA
White 12- by 12-Inch Textured Ceiling Tile	Room F	Y / M	NAD	Fair	PT5465AI32A PT5465AI32B	NA
Clear Fixture Caulk	Room F	N / M	NAD	Fair	PT5465AI33A PT5465AI33B	NA
Gray CWT Adhesive	Room F	N / M	NAD	Fair	PT5465AI34A PT5465AI34B	NA
White CWT Grout	Room F	N / M	NAD	Fair	PT5465AI35A PT5465AI35B	NA
White Window Caulk	Apartment Exterior	N / M	NAD	Fair	PT5465AI36A PT5465AI36B	NA
White Door Caulk	Apartment Exterior	N / M	NAD	Fair	PT5465AI37A PT5465AI37B	NA
Off-White Seam Tape	Room K	N / M	NAD	Fair	PT5465AI38A PT5465AI38B	NA
White Joint Compound	Room K	Y / M	NAD	Fair	PT5465AI39A PT5465AI39B	NA
White Gypsum Wall Board	Room K	N / M	NAD	Fair	PT5465AI40A PT5465AI40B	NA
Brown Cloth Electrical Wire Jacket	Throughout	N / M	NAD	Fair	PT5465AI41A PT5465AI41B	NA

**Table D-I**  
**Summary of Suspect ACM and Analytical Results**

<b>Material</b>	<b>General Location<sup>1</sup></b>	<b>Friable/ ACM Type</b>	<b>% Asbestos<sup>2A</sup></b>	<b>Condition</b>	<b>Sample Numbers</b>	<b>Estimated Quantity<sup>3, 4</sup></b>
Gray Window Glazing	Room J	N / M	NAD	Fair	PT5465AI42A PT5465AI42B	NA
Brown Insulation Backing Paper	Rooms I, J, N, O and P	N / T	NAD	Fair	PT5465AI43A PT5465AI43B PT5465AI43C	NA
Brown Fibrous Board	Room N and O	N / M	NAD	Fair	PT5465AI44A PT5465AI44B	NA
Black Tar Paper	Basement	N / M	NAD	Fair	PT5465AI45A PT5465AI45B	NA
Gray Seam Gasket	Garage Door Exterior Windows	N / M	NAD	Fair	PT5465AI46A PT5465AI46B	NA
White Window Caulk	East Center Exterior of Building	N / M	NAD	Fair	PT5465AI47A PT5465AI47B	NA
White Residual Door Caulk	East Center Exterior of Building	N / M	NAD	Fair	PT5465AI48A PT5465AI48B	NA
Black Asphalt Shingle	East Side Exterior – Behind South Beam	N / M	NAD	Fair	PT5465AI49A PT5465AI49B	NA
White Window Glazing	South Exterior Window	N / M	NAD	Fair	PT5465AI50A PT5465AI50B	NA
White Window Glazing	South Exterior Door Window	N / M	NAD	Fair	PT5465AI51A PT5465AI51B	NA
Black Textured Stair Tread	Room H	N / M	NAD	Fair	PT5465AI52A PT5465AI52B	NA
<b>Roofing Materials</b>	<b>Main Roof, Apartment Roof</b>	<b>N/M</b>	<b>Assumed</b>	<b>Fair</b>	<b>PT5465AI56</b>	<b>7,500 Square Feet</b>
<b>“L-Building”</b>						
<i>Black Asphalt Roll Roofing</i>	<i>Northeast Roof</i>	<i>N / M</i>	<i>Trace</i>	<i>Fair</i>	<i>PT5465AI53A PT5465AI53B</i>	<i>NA</i>
Black Asphalt Shingle	Main Roof	N / M	NAD	Fair	PT5465AI54A PT5465AI54B	NA
Black Asphalt Shingle	Main Roof - Rear Overhang	N / M	NAD	Fair	PT5465AI55A PT5465AI55B	NA

**Table D-II**  
**Summary of Suspect PCB-Containing Caulk and Analytical Results**

<b>Color / Material Description</b>	<b>General Location <sup>1</sup></b>	<b>Sample Number</b>	<b>Total PCB <sup>2b</sup> (ppm)</b>
Clear Fixture Caulk	Room F	PT5465PI33	0.406
White Window Caulk	Apartment Exterior	PT5465PI36	1.08
White Door Caulk	Apartment Exterior	PT5465PI37	0.71
White Window Caulk	East Center Exterior of Building	PT5465PI47	ND
White Residual Door Caulk	East Center Exterior of Building	PT5465PI48	ND

**Table D-III**

**Summary of Universal Waste/Miscellaneous Hazardous Materials**

<b>Equipment/Component</b>	<b>General Location</b>	<b>Approximate Quantity</b>	<b>Contaminant of Concern</b>
Fluorescent Lamps and High Pressure Sodium Lamps	Maintenance Garage	38	Mercury
Ballasts	Maintenance Garage	26	Potential PCB

## **APPENDIX E**

### **SUMMARY OF XRF RESULTS AND CALIBRATION CHECKS**

**Table E-I**  
**Summary of XRF Test Results - Lead Detected at Greater than or Equal to 1 mg/cm<sup>2</sup>**

Reading No.	Date	Time	Structure	Member	Substrate	Side	Condition	Color	Site	Room	Result (mg/cm <sup>2</sup> )
8	2/4/2021	13:07:49	Fascia	N/A	Wood	D	Deteriorated	Green	PT5465	L-Building	3.8
47	2/4/2021	4:07:49	Door	Frame	Wood	D	Intact	White	PT5465	D	1.1
48	2/4/2021	5:07:49	Window	Frame	Wood	B	Intact	White	PT5465	D	1.5
55	2/4/2021	12:07:49	Room	Ceiling	Plaster	Center	Intact	White	PT5465	E	1
56	2/4/2021	13:07:49	Room	Wall	Plaster	A	Intact	White	PT5465	E	1
67	2/4/2021	0:07:49	Room	Tub	Ceramic	Center	Intact	Pink	PT5465	F	30
85	2/5/2021	18:07:49	Room	Wall	Plaster	A	Deteriorated	Tan	PT5465	I	1.2
86	2/5/2021	19:07:49	Room	Wall	Brick	A	Deteriorated	Tan	PT5465	I	1.2
87	2/5/2021	20:07:49	Room	Wall	Brick	C	Intact	Tan	PT5465	I	1
97	2/5/2021	6:07:49	I-Beam	N/A	Metal	Center	Intact	Tan	PT5465	I	1
109	2/5/2021	18:07:49	Door	Frame	Wood	A	Intact	Tan	PT5465	M	1.3
112	2/5/2021	21:07:49	Room	Wall	Brick	D	Intact	Tan	PT5465	J	2.7
113	2/5/2021	22:07:49	Room	Wall	Wood	D	Intact	Tan	PT5465	J	2.2
115	2/5/2021	0:07:49	Radiator	---	Metal	C	Intact	Tan	PT5465	J	2.3
116	2/5/2021	1:07:49	Pipe	Vertical	Metal	C	Intact	Tan	PT5465	J	3.7
118	2/5/2021	3:07:49	Window	Frame	Wood	B	Intact	Tan	PT5465	J	5.2
124	2/5/2021	9:07:49	Room	Wall	Wood	A	Intact	Tan	PT5465	J	1.6
125	2/5/2021	10:07:49	Door	Frame	Wood	D	Intact	Tan	PT5465	J	5.5
133	2/5/2021	18:07:49	Room	Ceiling	Plaster	Center	Deteriorated	Tan	PT5465	L	1.1
134	2/5/2021	19:07:49	Room	Wall	Plaster	A	Deteriorated	Tan	PT5465	L	1
135	2/5/2021	20:07:49	Door	---	Wood	B	Deteriorated	Tan	PT5465	L	4.6
136	2/5/2021	21:07:49	Door	Frame	Wood	B	Deteriorated	Tan	PT5465	L	3.8
137	2/5/2021	22:07:49	Window	Casing	Wood	D	Deteriorated	Tan	PT5465	L	5.1
138	2/5/2021	23:07:49	Window	Frame	Wood	D	Deteriorated	Tan	PT5465	L	2.9
140	2/5/2021	1:07:49	Pipe	Horizontal	Metal	A	Deteriorated	Tan	PT5465	L	1.7
142	2/5/2021	3:07:49	Door	Frame	Wood	D	Intact	Gray	PT5465	N	6.5
144	2/5/2021	5:07:49	Window	Frame	Wood	D	Intact	Gray	PT5465	N	4
146	2/5/2021	7:07:49	Pipe	Vertical	Metal	D	Intact	Black	PT5465	N	1
148	2/5/2021	9:07:49	Room	Wall	Wood	A	Intact	Gray	PT5465	N	1.8
153	2/5/2021	14:07:49	Room	Wall	Wood	C	Intact	Gray	PT5465	N	6.5
167	2/5/2021	4:07:49	I-Beam	N/A	Metal	C	Deteriorated	Black	PT5465	O	1.8
169	2/5/2021	6:07:49	I-Beam	N/A	Metal	Center	Deteriorated	Black	PT5465	O	3.2
188	2/5/2021	1:07:49	Window	Casing	Wood	D	Deteriorated	White	PT5465	H	1.9
190	2/5/2021	3:07:49	Room	Baseboard	Wood	D	Intact	White	PT5465	H	3
192	2/5/2021	5:07:49	Stair	Risers	Wood	Center	Intact	Red	PT5465	H	2.8
193	2/5/2021	6:07:49	Stair	Stringer	Wood	Center	Intact	White	PT5465	H	2



**Table E-I**  
**Summary of XRF Test Results - Lead Detected at Greater than or Equal to 1 mg/cm<sup>2</sup>**

Reading No.	Date	Time	Structure	Member	Substrate	Side	Condition	Color	Site	Room	Result (mg/cm <sup>2</sup> )
194	2/5/2021	7:07:49	Stair	Railing	Wood	Center	Intact	White	PT5465	H	1.4
199	2/5/2021	12:07:49	Door	Frame	Wood	C	Deteriorated	White	PT5465	H	1.6
200	2/5/2021	13:07:49	Door	Frame	Wood	D	Deteriorated	White	PT5465	H	2.4
201	2/5/2021	14:07:49	Door	---	Wood	D	Deteriorated	White	PT5465	H	2
209	2/5/2021	22:07:49	Window	Frame	Metal	A	Deteriorated	Brown	PT5465	Exterior	5.5
210	2/5/2021	23:07:49	Window	Lintel	Metal	A	Deteriorated	Brown	PT5465	Exterior	5.6
212	2/5/2021	1:07:49	Door	Lintel	Metal	A	Deteriorated	Red	PT5465	Exterior	5.7
213	2/5/2021	2:07:49	I-Beam	N/A	Metal	A	Deteriorated	Brown	PT5465	Exterior	7.4
214	2/5/2021	3:07:49	Door	Frame	Wood	A	Deteriorated	Brown	PT5465	Exterior	3.6
215	2/5/2021	4:07:49	Door	Frame	Concrete	A	Deteriorated	Brown	PT5465	Exterior	4.2
222	2/5/2021	11:07:49	Door	Frame	Wood	C	Deteriorated	Brown	PT5465	Exterior	3.5
223	2/5/2021	12:07:49	I-Beam		Metal	C	Deteriorated	Brown	PT5465	Exterior	5.6
227	2/5/2021	16:07:49	Window	Frame	Metal	D	Deteriorated	Brown	PT5465	Exterior	5.9
228	2/5/2021	17:07:49	Window	Lintel	Metal	D	Deteriorated	Brown	PT5465	Exterior	5.7
229	2/5/2021	18:07:49	Door	---	Wood	D	Deteriorated	Brown	PT5465	Exterior	6.3
230	2/5/2021	19:07:49	Door	Frame	Wood	D	Deteriorated	Brown	PT5465	Exterior	9.5

**Table E-II**  
**Summary of XRF Test Results - Lead Detected at Less than 1 mg/cm<sup>2</sup>**

Reading No.	Date	Time	Structure	Member	Substrate	Side	Condition	Color	Site	Room	Result (mg/cm <sup>2</sup> )
7	2/4/2021	12:07:49	I-Beam	---	Metal	A	Deteriorated	Brown	PT5465	L-Building	0.6
9	2/4/2021	14:07:49	Support Column	---	Brick	D	Deteriorated	White	PT5465	L-Building	0.3
14	2/4/2021	19:07:49	Room	Wall	Wood	A	Intact	Brown	PT5465	A	0.4
16	2/4/2021	21:07:49	Window	Frame	Wood	A	Intact	White	PT5465	A	0.5
17	2/4/2021	22:07:49	Window	Sill	Wood	A	Intact	White	PT5465	A	0.6
18	2/4/2021	23:07:49	Window	Casing	Metal	A	Intact	White	PT5465	A	0.1
19	2/4/2021	0:07:49	Door	---	Wood	C	Intact	White	PT5465	A	0.2
20	2/4/2021	1:07:49	Door	Frame	Wood	C	Intact	White	PT5465	A	0.5
21	2/4/2021	2:07:49	Door	Frame	Wood	C	Intact	White	PT5465	A	0.5
22	2/4/2021	3:07:49	Door	---	Wood	C	Intact	White	PT5465	A	0.1
24	2/4/2021	5:07:49	Room	Ceiling	Plaster	Center	Intact	White	PT5465	A Closet	0.4
25	2/4/2021	6:07:49	Room	Wall	Plaster	A	Intact	White	PT5465	A Closet	0.5
26	2/4/2021	7:07:49	Door	Threshold	Wood	C	Intact	Gray	PT5465	A	0.2
27	2/4/2021	8:07:49	Door	---	Wood	C	Intact	White	PT5465	B	0.1
28	2/4/2021	9:07:49	Door	Frame	Wood	C	Intact	White	PT5465	B	0.4
31	2/4/2021	12:07:49	Room	Wall	Wood	D	Intact	White	PT5465	B	0.3
32	2/4/2021	13:07:49	Window	Frame	Wood	A	Intact	White	PT5465	B	0.6
33	2/4/2021	14:07:49	Window	Casing	Metal	A	Intact	White	PT5465	B	0.2
34	2/4/2021	15:07:49	Window	Sill	Wood	A	Intact	White	PT5465	B	0.4
36	2/4/2021	17:07:49	Room	---	Wood	Center	Intact	White	PT5465	B	0.1
38	2/4/2021	19:07:49	Room	Wall	Wood	A	Intact	White	PT5465	C	0.3
39	2/4/2021	20:07:49	Window	Sill	Wood	B	Intact	White	PT5465	C	0.3
40	2/4/2021	21:07:49	Window	Frame	Wood	B	Intact	White	PT5465	C	0.5
41	2/4/2021	22:07:49	Window	Casing	Metal	B	Intact	White	PT5465	C	0.1
42	2/4/2021	23:07:49	Door	---	Wood	D	Intact	White	PT5465	C	0.2
43	2/4/2021	0:07:49	Door	Frame	Wood	D	Intact	White	PT5465	C	0.4
44	2/4/2021	1:07:49	Door	Frame	Wood	C	Intact	White	PT5465	C	0.4
49	2/4/2021	6:07:49	Window	Sill	Wood	B	Intact	White	PT5465	D	0.2
50	2/4/2021	7:07:49	Window	Casing	Metal	B	Intact	White	PT5465	D	0.1
51	2/4/2021	8:07:49	Room	Wall	Wood	A	Intact	Off-White	PT5465	D	0.9
54	2/4/2021	11:07:49	Room	Ceiling	Wood	Center	Intact	White	PT5465	D	0.1
57	2/4/2021	14:07:49	Room	Baseboard	Wood	B	Intact	White	PT5465	E	0.7
58	2/4/2021	15:07:49	Room	Floor	---	Center	Intact	White	PT5465	D	0.6
59	2/4/2021	16:07:49	Window	Sill	Wood	C	Intact	White	PT5465	F	0.4
60	2/4/2021	17:07:49	Window	Casing	Wood	C	Intact	White	PT5465	F	0.5

**Table E-II**  
**Summary of XRF Test Results - Lead Detected at Less than 1 mg/cm<sup>2</sup>**

Reading No.	Date	Time	Structure	Member	Substrate	Side	Condition	Color	Site	Room	Result (mg/cm <sup>2</sup> )
61	2/4/2021	18:07:49	Window	Frame	Metal	C	Intact	White	PT5465	F	0.2
65	2/4/2021	22:07:49	Room	Sink	Ceramic	B	Intact	White	PT5465	F	0.2
66	2/4/2021	23:07:49	Room	Floor	Ceramic	Center	Intact	Pink	PT5465	F	0.2
68	2/4/2021	1:07:49	Radiator	Cover	Metal	D	Intact	White	PT5465	F	0.1
69	2/4/2021	2:07:49	Room	Ceiling	Wood	Center	Intact	White	PT5465	F	0.1
71	2/4/2021	4:07:49	Room	Wall	Wood	D	Intact	Stain	PT5465	G	0.4
72	2/4/2021	5:07:49	Window	Sill	Wood	D	Intact	White	PT5465	G	0.5
73	2/4/2021	6:07:49	Window	Frame	Wood	D	Intact	White	PT5465	G	0.6
74	2/4/2021	7:07:49	Window	Casing	Metal	D	Intact	White	PT5465	G	0.1
75	2/4/2021	8:07:49	Door	---	Wood	C	Intact	White	PT5465	G Closet	0.2
76	2/4/2021	9:07:49	Door	Frame	Wood	C	Intact	White	PT5465	G Closet	0.5
77	2/4/2021	10:07:49	Room	Wall	Plaster	A	Intact	White	PT5465	G Closet	0.5
78	2/4/2021	11:07:49	Room	Ceiling	Plaster	A	Intact	White	PT5465	G Closet	0.3
88	2/5/2021	21:07:49	Room	Floor	Concrete	Center	Deteriorated	Brown	PT5465	I	0.2
89	2/5/2021	22:07:49	Electric Panel	Frame	Metal	D	Deteriorated	Tan	PT5465	I	0.8
90	2/5/2021	23:07:49	Downspout	---	Metal	A	Intact	Tan	PT5465	I	0.2
91	2/5/2021	0:07:49	Window	Frame	Metal	D	Intact	Tan	PT5465	I	0.8
95	2/5/2021	4:07:49	Window	Sill	Wood	A	Intact	Tan	PT5465	I	0.7
96	2/5/2021	5:07:49	Room	Ceiling	Concrete	Center	Intact	Tan	PT5465	I	0.5
98	2/5/2021	7:07:49	Window	Frame	Metal	B	Intact	Tan	PT5465	I	0.8
100	2/5/2021	9:07:49	Shelf	---	Wood	B	Intact	Tan	PT5465	M	0.4
101	2/5/2021	10:07:49	Room	Wall	Plaster	C	Intact	Tan	PT5465	M	0.7
102	2/5/2021	11:07:49	Room	Ceiling	Plaster	Center	Intact	Tan	PT5465	M	0.7
104	2/5/2021	13:07:49	Window	Frame	Wood	D	Deteriorated	Tan	PT5465	M	0.3
105	2/5/2021	14:07:49	Window	Casing	Wood	D	Deteriorated	Tan	PT5465	M	0.8
106	2/5/2021	15:07:49	Window	Shutter	Wood	D	Deteriorated	Tan	PT5465	M	0.3
107	2/5/2021	16:07:49	Pipe	Vertical	Metal	D	Intact	Tan	PT5465	M	0.1
108	2/5/2021	17:07:49	Door	---	Wood	A	Intact	Tan	PT5465	M	0.1
110	2/5/2021	19:07:49	Room	Floor	Concrete	Center	Intact	Gray	PT5465	M	0.5
111	2/5/2021	20:07:49	Room	Floor	Concrete	Center	Intact	Gray	PT5465	J	0.3
114	2/5/2021	23:07:49	Room	Wall	Brick	A	Intact	Tan	PT5465	J	0.1
119	2/5/2021	4:07:49	Electric Panel	Frame	Metal	B	Intact	Tan	PT5465	J	0.5
120	2/5/2021	5:07:49	I-Beam	N/A	Metal	B	Intact	Tan	PT5465	J	0.6
122	2/5/2021	7:07:49	Room	Ceiling	Concrete	B	Intact	Tan	PT5465	J	0.1
123	2/5/2021	8:07:49	Room	Wall	Brick	A	Intact	Tan	PT5465	J	0.2

**Table E-II**  
**Summary of XRF Test Results - Lead Detected at Less than 1 mg/cm2**

Reading No.	Date	Time	Structure	Member	Substrate	Side	Condition	Color	Site	Room	Result (mg/cm <sup>2</sup> )
126	2/5/2021	11:07:49	Door	---	Wood	A	Intact	Stain	PT5465	K	0.1
128	2/5/2021	13:07:49	Room	Wall	Brick	B	Intact	Tan	PT5465	K	0.1
129	2/5/2021	14:07:49	Access Panel	Door	Metal	B	Intact	Tan	PT5465	K	0.2
130	2/5/2021	15:07:49	Radiator	Cover	Metal	Center	Intact	Blue	PT5465	K	0.1
131	2/5/2021	16:07:49	Room	Floor	Concrete	Center	Intact	Gray	PT5465	K	0.4
132	2/5/2021	17:07:49	Room	Floor	Concrete	Center	Intact	Tan	PT5465	L	0.4
139	2/5/2021	0:07:49	Window	Shutter	Wood	D	Deteriorated	Tan	PT5465	L	0.9
141	2/5/2021	2:07:49	Room	Wall	Brick	D	Intact	Gray	PT5465	N	0.1
143	2/5/2021	4:07:49	I-Beam	N/A	Metal	D	Intact	Gray	PT5465	N	0.7
145	2/5/2021	6:07:49	Room	Wall	Brick	D	Intact	Red	PT5465	N	0.1
147	2/5/2021	8:07:49	Room	Wall	Wood	A	Intact	Black	PT5465	N	0.9
149	2/5/2021	10:07:49	Electric Panel	Door	Metal	A	Deteriorated	Gray	PT5465	N	0.2
150	2/5/2021	11:07:49	Window	Lintel	Metal	D	Deteriorated	Gray	PT5465	N	0.1
151	2/5/2021	12:07:49	Room	Ceiling	Gypsum	D	Intact	Gray	PT5465	N	0.7
152	2/5/2021	13:07:49	Room	Wall	Brick	C	Intact	Gray	PT5465	N	0.3
155	2/5/2021	16:07:49	Door	---	Metal	C	Intact	White	PT5465	N	0.1
156	2/5/2021	17:07:49	I-Beam	N/A	Metal	Center	Intact	Black	PT5465	N	0.6
157	2/5/2021	18:07:49	Window	Frame	Wood	C	Intact	White	PT5465	N	0.1
158	2/5/2021	19:07:49	I-Beam	N/A	Metal	Center	Intact	Yellow	PT5465	N	0.6
159	2/5/2021	20:07:49	I-Beam	N/A	Metal	Center	Intact	Red	PT5465	N	0.3
160	2/5/2021	21:07:49	Electric Panel	Door	Metal	B	Intact	Gray	PT5465	O	0.2
161	2/5/2021	22:07:49	Electric Panel	Frame	Metal	B	Intact	Gray	PT5465	O	0.2
162	2/5/2021	23:07:49	Electric Panel	Frame	Metal	B	Intact	Gray	PT5465	O	0.1
163	2/5/2021	0:07:49	Electric Panel	Frame	Metal	B	Intact	Gray	PT5465	O	0.1
164	2/5/2021	1:07:49	Pipe	Vertical	Metal	A	Deteriorated	Black	PT5465	O	0.2
165	2/5/2021	2:07:49	Compressor	---	Metal	B	Deteriorated	Black	PT5465	O	0.4
166	2/5/2021	3:07:49	Door	Frame	Metal	C	Intact	Orange	PT5465	O	0.3
170	2/5/2021	7:07:49	Door	---	Wood	B	Deteriorated	Gray	PT5465	O	0.4
171	2/5/2021	8:07:49	Door	Frame	Metal	B	Deteriorated	Gray	PT5465	O	0.7
173	2/5/2021	10:07:49	Door	---	Metal	C	Intact	White	PT5465	O	0.1
174	2/5/2021	11:07:49	Door	---	Metal	C	Intact	White	PT5465	P	0.1
175	2/5/2021	12:07:49	Room	Ceiling	Gypsum	Center	Intact	Gray	PT5465	P	0.1
180	2/5/2021	17:07:49	Room	Floor	Concrete	Center	Deteriorated	Red	PT5465	P	0.8
181	2/5/2021	18:07:49	Room	Floor	Concrete	Center	Deteriorated	Gray	PT5465	P	0.6
186	2/5/2021	23:07:49	Room	Wall	Wood	A	Intact	Off-White	PT5465	H	0.3

**Table E-II**  
**Summary of XRF Test Results - Lead Detected at Less than 1 mg/cm<sup>2</sup>**

Reading No.	Date	Time	Structure	Member	Substrate	Side	Condition	Color	Site	Room	Result (mg/cm <sup>2</sup> )
187	2/5/2021	0:07:49	Window	Sill	Wood	D	Deteriorated	White	PT5465	H	0.8
189	2/5/2021	2:07:49	Window	Frame	Metal	D	Intact	White	PT5465	H	0.1
198	2/5/2021	11:07:49	Door	---	Wood	C	Deteriorated	White	PT5465	H	0.1
202	2/5/2021	15:07:49	Room	Ceiling	Concrete	Center	Deteriorated	Black	PT5465	Basement	0.3
203	2/5/2021	16:07:49	I-Beam	N/A	Metal	Center	Deteriorated	Black	PT5465	Basement	0.3
204	2/5/2021	17:07:49	Room	Wall	Plaster	D	Deteriorated	Black	PT5465	Basement	0.3
205	2/5/2021	18:07:49	Door	---	Metal	A	Deteriorated	Brown	PT5465	Exterior	0.1
207	2/5/2021	20:07:49	Door	Sidelight	Wood	A	Deteriorated	Tan	PT5465	Exterior	0.1
208	2/5/2021	21:07:49	Window	Sill	Concrete	A	Deteriorated	Brown	PT5465	Exterior	0.2
211	2/5/2021	0:07:49	Door	Lintel	Metal	A	Deteriorated	Red	PT5465	Exterior	0.2
216	2/5/2021	5:07:49	Pipe	Vertical	Metal	A	Deteriorated	Green	PT5465	Exterior	0.4
217	2/5/2021	6:07:49	Room	Wall	Brick	B	Deteriorated	Off-White	PT5465	Exterior	0.1
218	2/5/2021	7:07:49	Window	Sill	Concrete	B	Deteriorated	Off-White	PT5465	Exterior	0.3
219	2/5/2021	8:07:49	Window	Frame	Metal	B	Deteriorated	Black	PT5465	Exterior	0.2
220	2/5/2021	9:07:49	Room	Wall	Brick	C	Deteriorated	Off-White	PT5465	Exterior	0.1
221	2/5/2021	10:07:49	Door	Frame	Wood	C	Deteriorated	White	PT5465	Exterior	0.6
225	2/5/2021	14:07:49	Pipe	Vertical	Metal	C	Deteriorated	Brown	PT5465	Exterior	0.4
226	2/5/2021	15:07:49	Window	Sill	Concrete	D	Deteriorated	Brown	PT5465	Exterior	0.1

**Table E-III**  
**Summary of XRF Test Results - No Lead Detected**

Reading No.	Date	Time	Structure	Member	Substrate	Side	Condition	Color	Site	Room	Result (mg/cm <sup>2</sup> )
15	2/4/2021	20:07:49	Room	Ceiling	Wood	A	Intact	White	PT5465	A	0
23	2/4/2021	4:07:49	Room	Floor	Wood	Center	Intact	Stain	PT5465	A	0
29	2/4/2021	10:07:49	Door	---	Wood	C	Intact	White	PT5465	B	0
30	2/4/2021	11:07:49	Room	Wall	Wood	C	Intact	White	PT5465	B	0
35	2/4/2021	16:07:49	Radiator	Cover	Metal	A	Intact	White	PT5465	B	0
37	2/4/2021	18:07:49	Room	Ceiling	Wood	Center	Intact	White	PT5465	C	0
45	2/4/2021	2:07:49	Door	Frame	Wood	C	Intact	White	PT5465	D	0
46	2/4/2021	3:07:49	Door	---	Wood	C	Intact	White	PT5465	D	0
52	2/4/2021	9:07:49	Cabinets	Door	Wood	D	Intact	Off-White	PT5465	D	0
53	2/4/2021	10:07:49	Cabinets	Frame	Wood	D	Intact	Off-White	PT5465	D	0
62	2/4/2021	19:07:49	Room	Wall	Ceramic	D	Intact	Pink	PT5465	F	0
63	2/4/2021	20:07:49	Room	Wall	Plaster	D	Intact	Gray	PT5465	F	0
64	2/4/2021	21:07:49	Room	Toilet	Ceramic	C	Intact	Pink	PT5465	F	0
70	2/4/2021	3:07:49	Room	Ceiling	Wood	Center	Intact	White	PT5465	G	0
93	2/5/2021	2:07:49	Door	Frame	Metal	A	Intact	Tan	PT5465	I	0
94	2/5/2021	3:07:49	Door	Header	Wood	A	Intact	Tan	PT5465	I	0
99	2/5/2021	8:07:49	Shelf	---	Wood	D	Intact	Tan	PT5465	I	0
103	2/5/2021	12:07:49	Room	Sink	Ceramic	C	Intact	White	PT5465	M	0
117	2/5/2021	2:07:49	Room	Wall	Gypsum	C	Intact	Off-White	PT5465	J	0
121	2/5/2021	6:07:49	Radiator	Cover	Wood	B	Intact	Stain	PT5465	J	0
127	2/5/2021	12:07:49	Room	Wall	Brick	B	Intact	Tan	PT5465	K	0
154	2/5/2021	15:07:49	Room	Wall	Wood	C	Intact	White	PT5465	N	0
168	2/5/2021	5:07:49	Room	Ceiling	Gypsum	Center	Intact	Gray	PT5465	O	0
172	2/5/2021	9:07:49	Room	Wall	Brick	B	Intact	Gray	PT5465	O	0
176	2/5/2021	13:07:49	Cabinets	Door	Wood	B	Intact	Light Blue	PT5465	P	0
177	2/5/2021	14:07:49	Cabinets	Door	Wood	B	Intact	Light Blue	PT5465	P	0
178	2/5/2021	15:07:49	Room	Wall	Wood	A	Intact	Light Blue	PT5465	P	0
191	2/5/2021	4:07:49	Stair	Treads	Wood	Center	Intact	Red	PT5465	H	0
195	2/5/2021	8:07:49	Stair	Railing	Wood	Center	Intact	Stain	PT5465	H	0
196	2/5/2021	9:07:49	Stair	Newel Post	Wood	Center	Intact	Stain	PT5465	H	0
197	2/5/2021	10:07:49	Room	Ceiling	Wood	Center	Intact	White	PT5465	H	0
206	2/5/2021	19:07:49	Door	Frame	Wood	A	Deteriorated	Brown	PT5465	Exterior	0
224	2/5/2021	13:07:49	Room	Wall	Brick	C	Deteriorated	White	PT5465	Exterior	0

**Table E-IV**  
**Summary of XRF Calibration Results**

Reading No.	Date	Time	Structure	Member	Substrate	Side	Condition	Color	Site	Room	Result (mg/cm <sup>2</sup> )
4	2/4/2021	9:07:49				Calibration			PT5465		1
5	2/4/2021	10:07:49				Calibration			PT5465		1
6	2/4/2021	11:07:49				Calibration			PT5465		1
11	2/4/2021	16:07:49				Calibration			PT5465		1
12	2/4/2021	17:07:49				Calibration			PT5465		1
13	2/4/2021	18:07:49				Calibration			PT5465		1
79	2/4/2021	12:07:49				Calibration			PT5465		1.1
80	2/4/2021	13:07:49				Calibration			PT5465		1
81	2/4/2021	14:07:49				Calibration			PT5465		1
82	2/5/2021	15:07:49				Calibration			PT5465		1
83	2/5/2021	16:07:49				Calibration			PT5465		0.9
84	2/5/2021	17:07:49				Calibration			PT5465		0.9
182	2/5/2021	19:07:49				Calibration			PT5465		1
183	2/5/2021	20:07:49				Calibration			PT5465		1
184	2/5/2021	21:07:49				Calibration			PT5465		1
185	2/5/2021	22:07:49				Calibration			PT5465		1
231	2/5/2021	20:07:49				Calibration			PT5465		1
232	2/5/2021	21:07:49				Calibration			PT5465		1.1
233	2/5/2021	22:07:49				Calibration			PT5465		1.1

003132 - GEOTECHNICAL DATA

1.1 GEOTECHNICAL DATA

- A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information. This Document and its attachments are not part of the Contract Documents.
- B. Because subsurface conditions indicated by the soil borings are a sampling in relation to the entire construction area, and for other reasons, the Owner, the Architect, the Architect's consultants, and the firm reporting the subsurface conditions do not warranty the conditions below the depths of the borings or that the strata logged from the borings are necessarily typical of the entire site. Any party using the information described in the soil borings and geotechnical report shall accept full responsibility for its use.
- C. Soil-boring data for Project, obtained by Soiltesting, Inc., dated January 8, 2020, is available for viewing as appended to this Document integral to the geotechnical investigation report.
- D. A geotechnical investigation report for Project, prepared by Skylands Engineering, dated February 14, 2020, is available for viewing as appended to this Document. This document includes soil boring data
  - 1. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from the data.
- E. Related Requirements:
  - 1. City of Rye contract documents for the Bidder's responsibilities for examination of Project site and existing conditions.

END OF SECTION 003132



Phone  
(203) 262-9328

Telefax  
(203) 264-3414



WHITE PLAINS, N.Y.  
(914) 946-4850

## SOILTESTING, INC.

90 DONOVAN ROAD - OXFORD, CONN. 06478-1028

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GEOTECHNICAL / ENVIRONMENTAL SUBSURFACE INVESTIGATIONS - Test Borings - Core Drilling  
Monitoring Wells - Recovery Wells - Direct Push/Probe Sampling  
UNDERPINNING - HELICAL PILES - SOIL NAILS

---

February 18, 2020

Stantec Consulting Services, Inc.  
55 Church Street, Suite 601  
New Haven, CT 06510  
203-495-1645

cc: Jeff Olszewski

Attn: Anna Schmiedicke

Re: Oakland Beach Ave  
Rye, NY

G4-1436-19

Dear Ms. Schmiedicke,

Enclosed is the Geotechnical Report, boring logs and location plan for the above referenced project site.

If you have any questions, please do not hesitate to contact us.

Very truly yours,

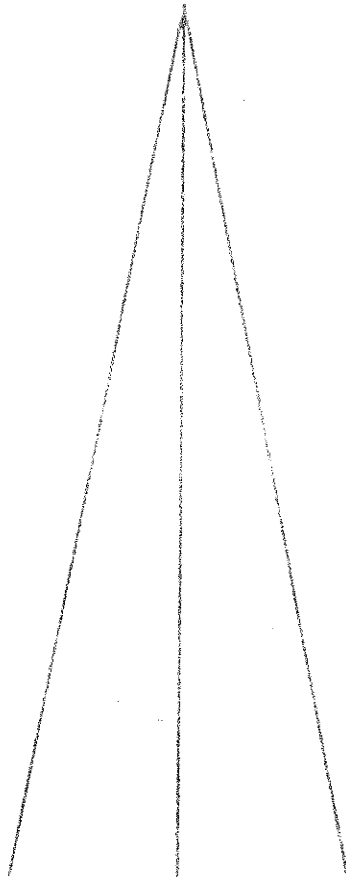
**SOILTESTING, INC.**

James A. DeAngelis  
President

JAD:cl

# SOILTESTING, INC.

TO ..... Stantec Consulting Services, Inc. .... DATE ..... February 18, 2020 ..  
ADDRESS ..... 55 Church Street, Suite 601, New Haven, CT 06510 .....  
SITE LOCATION ..... Oakland Beach Ave, Rye, NY, .....  
REPORT SENT TO ..... Anna Schmiedicke .....  
SAMPLES SENT TO ..... Storage (Max. 60 days) .....



**90 DONOVAN ROAD**  
Oxford, Connecticut 06478  
**(203) 262-9328**

Branch Office:  
White Plains, New York 10607  
914-946-4850

JOB NO.  
**G4-1436-19**

# **Geotechnical Engineering Report**

**by**

**Skylands Engineering, LLC**

**for**

**Soiltesting, Inc.**

**Dated: 2/14/2020**

***141 Oakland Beach Ave Rye, NY***

**Stantec Consulting Services, Inc.**

***City of Rye***

**G4-1436-19**



# Geotechnical Report

## **City of Rye** DPW Facility Improvements

141 Oakland Beach Avenue  
Rye, New York

February 14, 2020

Prepared for:

**Stantec Consulting**  
55 Church Street, Suite 601  
New Haven, CT 06510

Prepared by:

**SKYLANDS ENGINEERING, LLC**  
124 Milton Road  
Sparta, NJ 07871

# Geotechnical Report

## City of Rye DPW Facility Improvements

141 Oakland Beach Avenue  
Rye, New York

February 14, 2020

Prepared for:

**Stantec Consulting**  
55 Church Street, Suite 601  
New Haven, CT 06510

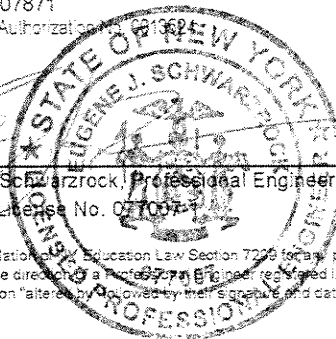
Prepared by:

**SKYLANDS ENGINEERING, LLC**  
124 Milton Road  
Sparta, NJ 07871  
Certificate of Authorization

Eugene J. Schwarzkopf, Professional Engineer  
New York License No. 071007-1

Date

Note: It is a violation of Education Law Section 7206 for any person to alter any item in this report in any way, unless they are acting under the direction of a Professional Engineer registered in New York. The altering engineer shall affix to this page their seal, the notation "altered by" followed by their signature and date of alteration, and a specific description of the alteration(s) made.



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### APPENDIX

Boring Location Plan  
Boring Logs  
Rock Core Photo



## INTRODUCTION

This project involves the design and construction/reconstruction of three (3) buildings located at the City of Rye Department of Public Works (DPW) facility located at 141 Oakland Beach Avenue, Rye, Westchester County, New York. Included in this project are the replacement of a DPW truck garage building (Building 5) and the reconstruction of a portion of a nearby second garage building (Building 7), both situated in the southern end of the DPW facility, and construction of a new Salt Shed and Recycling Depot (Salt Shed) in the northern end of the DPW facility. Building 5 is a mostly single-story, 55 ft. x 140 ft. garage, with a second floor covering the southern 25 ft. of the building. This building is scheduled to be replaced by a new garage building of similar size and location, and with a partial 2<sup>nd</sup> floor for office space. Building 7 renovations include the removal and replacement of the eastern wall and the adjacent easternmost 28 ft. of the southern wall. These  $\pm 10$  ft. tall concrete block walls will be replaced by CIP concrete walls on new foundations. The new Salt Shed will be 80 ft. wide x 140 ft., with its long axis oriented generally in a N-S direction. It will be built in an open area of the facility; however, two (2) mounds of fill exist within the proposed center-east and northeast areas of the Salt Shed, with the center-east fill  $\pm 20$  ft. tall, and the northeast fill  $\pm 32$  ft. tall. No basements are planned for any of these buildings.

Grades across the area of Buildings 5 and 7 are generally flat and are assumed to range from El.  $\pm 16$  in the west to El.  $\pm 25$  in the east based on elevations obtained from Google Earth since no survey is available for this area. Grades in the area of the proposed Salt Shed vary from El.  $\pm 10$  in the southwest to El.  $\pm 30$  in the northeast based on site plans for this area.

This report presents the findings of a subsurface investigation prepared and conducted by others specifically for this project, as well as geotechnical recommendations for design and construction of the proposed improvements.

## GEOLOGY

Based on our review of published geologic data for this area of Westchester County, including the *Surficial Geologic Map of New York - Lower Hudson Sheet*, 1989, by Cadwell, Connally, et. al., this site is expected to be underlain by glacial till of varying thickness and consisting of poorly sorted sands, silts and clays with boulders. Underlying bedrock is expected to consist of Hartland formation schist overlying amphibolite, or Harrison gneiss based on the *Bedrock Geology of the Mamaroneck Quadrangle, N.Y.*, 1977, by Pelligrini and the *(Bedrock) Geologic Map of New York - Lower Hudson Sheet*, 1970, by Rickard, Isachsen, and Fisher.

## SUBSURFACE INVESTIGATION

Soiltesting, Inc. of Oxford, Connecticut performed nine (9) borings between January 8 and 10, 2020 to identify the subsurface conditions present beneath the proposed buildings and salt shed. Borings B-1, B-1A and B-2 were performed at opposite corners of Building 5, borings B-3 and B-4 were performed at opposite corners of the area to be reconstructed at Building 7, and borings B-5 through B-8 were drilled between  $\pm 15$  ft. and  $\pm 70$  ft. outside the proposed footprint of the Salt Shed. The ground elevations at each boring were estimated as per the current Site Plan. All borings were sampled continuously to a depth of  $\pm 12$  ft., then at 5 ft. intervals to the bottoms of the borings, which ranged from 2.5 ft. to 34 ft.



All borings were drilled using a truck-mounted drill rig and a 3¼ in. diameter hollow stem auger to advance and maintain the hole. Sampling was performed using a 2 in. O.D. split spoon sampler driven by a 140 lb. safety hammer with a 30 in. drop and the number of blows for each 6 in. increment was recorded, in accordance with procedures outlined in ASTM D1586, Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils. Bedrock was cored from borings B-4 and B-6 using an N-size core barrel in accordance with ASTM D 2113 - Standard Practice for Rock Core Drilling and Sampling. Soil samples were classified by an experienced geologist from Soiltesting, generally in accordance with D.M. Burmister's "Suggested Test Methods for Identification of Soils" (ASTM, 1958). Bedrock samples were also classified by an experienced geologist from Soiltesting according to their rock type, origin, and measured percentage recovery and rock quality designation (RQD).

Groundwater was recorded when it was first encountered in each of the boring since all borings were performed without the introduction of water.

A Boring Location Plan and typed boring logs are presented in the Appendix. The boring logs were amended by Skylands Engineering to include estimated ground elevations and bedrock core recoveries.

## **SUBSURFACE CONDITIONS**

The subsurface conditions encountered beneath this site are in general agreement with the published geologic literature. At Building 5, brown, very loose to mostly medium dense, granular fill containing coarse to fine sand with gravel was encountered in borings B-1 and B-2 to depths ranging from 3.5 ft. to 6.6 ft. Below this fill, brown, loose to mostly medium dense, fine and coarse to fine sand with varying minor amounts of gravel was present to the top of probable bedrock. Standard penetration test N-values ranged from 4 blows per foot (bpf) to 23 bpf, with  $N_{ave}=\pm 15$  bpf. Very high N-values, possibly indicative of weathered bedrock, was encountered in borings B-1 and B-2 at depths of 6.5 ft. (El.  $\pm 12.5$ ) and 19 ft. (El.  $\pm 2$ ), respectively. Auger refusal, believed to be the top of more competent/less weathered bedrock, was encountered in these borings at depths of 7 ft. (El.  $\pm 12$ ) and 20.5 ft. (El.  $\pm 3.5$ ), respectively. Groundwater was not encountered in boring B-1 since this boring only advanced to a depth of 7 ft., but was encountered in boring B-2 at a depth of 8 ft. (El.  $\pm 9$ ). Given the sandy soil conditions, the fact the borings were drilled without the introduction of water, and the continuously wet samples below where water was first encountered, this water level is expected to be static water and not a temporary or perched condition.

At Building 7, brown, loose to mostly medium dense, medium to fine and coarse to fine sand with significant amounts of gravel and cobbles was present from the ground surface to auger refusal. Standard penetration test N-values ranged from 9 bpf to 81 bpf, with  $N_{ave}=\pm 31$  bpf. Very high N-values, possibly indicative of weathered bedrock, was encountered in boring B-3 at a depth of 10.5 ft. (El.  $\pm 12.5$ ) while auger refusal, was encountered in boring B-3 and B-4 at depths of 15 ft. (El.  $\pm 8$ ) and 18 ft. (El.  $\pm 12$ ), respectively. A 5 ft. bedrock core sampled beginning at auger refusal in boring B-4 indicated schist and/or gneiss bedrock is present, with 83% recovery and 63% rock quality designation, considered fair to good for schist/gneiss bedrock. Groundwater was not encountered in boring B-4, but was encountered in boring B-3 at a depth of 8 ft. (El.  $\pm 15$ ). Similar to above, given the sandy soil conditions, the fact the borings were drilled without the introduction of water, and the continuously wet samples below where water was first encountered, this water level is expected to be static water and not a temporary or perched condition.





At the Salt Shed, gray, black and brown, mostly loose to medium dense and dense, granular fill containing mostly fine and medium to fine sand with varying amounts of gravel and silt was encountered in borings B-5 through B-8 to depths ranging from 4.5 ft. (El.  $\pm 5.5$ ) in the southwest, 9 ft. (El.  $\pm 19$ ) in the northeast. This fill was generally free of organics and other non-soil components, with only trace amounts of roots encountered at boring B-5 at a depth of 6 ft (El.  $\pm 6$ ), and glass, brick and concrete only encountered in boring B-6 at depths ranging from 4 ft. to 9 ft. (El.  $\pm 24$  to El.  $\pm 19$ ). Below this fill, brown, gray-brown and black, loose to mostly medium dense, fine and medium to fine sand with varying amounts of gravel and silt was present to the top of bedrock. Standard penetration test N-values in the surficial fills ranged from 5 bpf to 43 bpf, with  $N_{ave} = \pm 12$  bpf. Standard penetration test N-values in these underlying native soils ranged from 7 bpf to 40 bpf, with  $N_{ave} = \pm 17$  bpf. Very high N-values, indicative of weathered bedrock, was encountered in borings B-5, B-6, and B-8 at depths of 30 ft. (El.  $\pm -18$ ), 15 ft. (El.  $\pm 13$ ), and 15 ft. (El.  $\pm 5$ ), respectively. Less weathered bedrock, indicated by auger refusal and retrieval of a bedrock core sample from boring B-6, indicated schist bedrock is present at depths ranging from 15.5 ft. (El.  $\pm 12.5$ ) in the northeast to 34 ft. (El.  $\pm -24$ ) in the southwest. A 5 ft. bedrock core beginning at auger refusal in boring B-6 indicated schist bedrock is present beneath the Salt Shed, with 92% recovery and 53% rock quality designation, considered fair to good for schist bedrock. Groundwater was encountered in the two (2) lower borings, B-5 and B-7, at a depth of 8 ft. (El.  $\pm 4$  to El.  $\pm 2$ ). Note that the other two (2) borings located here were located on significantly higher ground, and the bottom of these borings only approached the groundwater elevation before encountering bedrock. Nonetheless, considering the sandy soil, the borings were drilled without the introduction of water, the continuously wet samples below where water was first encountered in borings B-5 and B-7, and the presence of the nearby these water levels are expected to be static water and not a temporary or perched condition. Further, the water level is also expected to be influenced by the tides, given the short distance to Milton Harbor and the generally sandy soils.

## DESIGN RECOMMENDATIONS

### BUILDING 5

Based on the findings of the above-described subsurface investigation program, it is recommended that conventional shallow foundations are suitable for support of the replacement DPW Building 5. The recommended footing/frost depth for this area of New York is 42 in. below final exterior grade therefore bottoms of footings should be located at or below this depth to prevent frost heave damage. Proposed grades around the building are expected to remain as is, which vary from El.  $\pm 17$  to El.  $\pm 20$  according to Google Earth, therefore footings are expected to be constructed between El.  $\pm 13.5$  and El.  $\pm 16.5$ . As such, footings are expected to be founded within mostly medium dense sands, either of natural origin or possibly fill, and with somewhat variable relative density. It is therefore recommended that 24 in. of soil be removed from beneath each footing and replaced with compacted granular structural fill. During this over-excavation and backfilling operation, the soil at the bottom of the excavation should be inspected for the presence of organics, wood or other deleterious material and any such material should be removed completely from below each footing. The over-excavation should be thoroughly compacted using a minimum of 4 passes of a vibratory trench roller/compactor, and until no further settlement is visible, prior to backfilling up to the bottom of footing with compacted structural fill. Footing over-excavations should extend 6 in. on each side for every 12 in. of excavation to minimize post-construction settlement. Footings constructed according to these recommendations may be designed using an allowable bearing capacity of 2 ton per square foot (tsf). A coefficient of base sliding of 0.45 is recommended based on the soils present at the anticipated bottoms of footings and use of structural



fill. Minimum footing widths of 24 in. for wall footings and 36 in. for column footings are recommended to limit settlements. Following the above recommendations, it is estimated that maximum post construction foundation settlement will be no more than  $\frac{1}{2}$  in., with no more than  $\frac{3}{8}$  in. differential settlement between adjacent columns. These values are within generally accepted tolerance limits for this type of structure/use. Settlement is expected to be elastic (instantaneous), with no long-term consolidation settlement occurring.

The garage floor may be economically designed as a concrete slab-on-grade following construction of the footings, and proof-rolling and compaction of the subgrade. The subgrade should be proof-rolled and compacted using a minimum of 2 passes of a 10 T vibratory roller away from new footings, or 4 passes of a vibratory trench roller, and until no further settlement is visible. A modulus of subgrade reaction equal to 250 lb./in.<sup>3</sup> (pci) is recommended for design of slabs on grade constructed in this manner. Underslab drainage should not be necessary since groundwater is expected to be  $\geq 8$  ft. below the slab.

## **BUILDING 7**

Similar to above, it is recommended that spread footings constructed on improved subgrade be used for support of the reconstructed portion of Building 7. Elevations of the two (2) borings taken here are unknown, however boring B-3 was performed at the pavement elevation in front of the building. Based on data from Google Earth the ground at boring B-3 appears to be at El.  $\pm 23$  while the ground at boring B-4 appears to be at El.  $\pm 30$ . This difference in boring elevations appears to be confirmed by wall cross sections shown on the Progress Plan for this building, which indicates the ground along the rear of the wall will be 6.5 ft. to 9 ft. higher than the garage floor. Footings are expected to be constructed at or below El.  $\pm 19.5$ . Soils at this elevation are expected to be virgin, medium dense sands with variable relative density. It is recommended that 24 in. of soil be removed from beneath the footings and replaced with compacted granular structural fill. The over-excavation should be thoroughly compacted using a minimum of 4 passes of a vibratory trench roller/compactor, and until no further settlement is visible, prior to backfilling up to the bottom of footing with compacted structural fill. Footing over-excavations should extend 6 in. on each side for every 12 in. of excavation to minimize post-construction settlement. Footings constructed according to these recommendations may be designed using an allowable bearing capacity of 2 tsf and a coefficient of base sliding of 0.45. Minimum footing widths of 24 in. for wall footings and 36 in. for column footings are recommended to limit settlements, which are estimated to be no more than  $\frac{1}{2}$  in. total settlement, and no more than  $\frac{3}{8}$  in. differential settlement between columns. These values are within generally accepted tolerance limits for this type of structure/use. Settlement is expected to be elastic, with no long-term settlement occurring.

Similar to at Building 5 the garage floor may be economically designed as a concrete slab-on-grade following construction of the footings, and proof-rolling and compaction of the subgrade. The subgrade should be proof-rolled and compacted using a minimum of 2 passes of a 10 T vibratory roller away from new footings, or 4 passes of a vibratory trench roller, and until no further settlement is visible. A modulus of subgrade reaction equal to 250 pci is recommended for design of slabs on grade constructed in this manner. Underslab drainage should not be necessary since groundwater is expected to be  $\geq 8$  ft. below the slab.



## SALT SHED & RECYCLING DEPOT

Based on the current site plans for the Salt Shed, the finish floor of the new building will be at El. 17, with surrounding grades at El. 13.5 to the west and El. 17 to the north, east, and south. Existing grades within the proposed shed footprint vary from El. 10 in the southwest to El. 34 in the northeast. Depending on the requirements of the salt shed, it is recommended the new shed may be constructed using conventional cast-in-place walls atop spread footings founded at frost depth. Footings are expected to be constructed at or below El. 10 along the west wall, and El. 13.5 along the other three (3) walls. Along the west side of the building, granular fill with highly variable relative density and trace organics are present to a depth of  $\pm 4.5$  ft. below the footings (to El. 5.5). These soils should be removed and replaced with compacted structural fill to provide uniform and suitable support for the structure. Groundwater is expected to be close to this elevation therefore crushed stone or recycled concrete aggregate (RCA) may be required in the lower portion of this excavation to prevent softening and allow proper compaction of the subgrade. Along the east side of the building, footing excavations are expected to be carried through the fill layer and into medium dense to very dense virgin sands. Should any fill exist at the bottom of footing, it should be removed down to virgin soils and additional structural fill and/or crushed stone placed back up to the bottom of footing elevation(s). This will be especially important to look for along the two (2) short walls (north and south walls), which appear to run parallel with the fill slope line. Groundwater is not expected to be encountered beneath this area of the building. Similar to above recommendations, the bottoms of all over excavations should be thoroughly compacted until no further settlement is visible and over excavations should extend 6 in. on each side for every 12 in. of excavation to minimize post-construction settlement. Footings constructed according to these recommendations may be designed using an allowable bearing capacity of 2 tsf and a coefficient of base sliding of 0.45. Minimum footing widths of 24 in. for wall footings and 36 in. for column footings are recommended to limit settlements, which are estimated to be no more than  $\frac{3}{4}$  in. total settlement, and no more than  $\frac{3}{8}$  in. differential settlement between columns. Settlement should be elastic, with no long-term settlement occurring.

The western  $\pm \frac{1}{2}$  of the building will require fills of up to 7 ft. to reach finish grade, while the eastern side of the building will require cuts of up to 17 ft. At the start of site grading operations, the existing pavement should be broken up and removed or crushed for reuse in fill areas, if permitted. The majority of the material to be cut from the site may be similar to that fill encountered in boring B-6, namely black fine sand with gravel, glass, brick and concrete. It is recommended that this material not be used as fill without further investigation and testing to determine its extent/quantity and compaction properties. If found to be consistent and suitable, it is recommended that this material may be placed in the lower areas of fill, and no higher than 18 in. below the bottom of the Salt Shed slab. In cut areas, the above described fill material should be cut to a depth of 18 in. below the bottom of slab, then structural fill placed up to the required subgrade elevation. Following this procedure for subgrade preparation, a modulus of subgrade reaction equal to 200 pci is recommended for design of slabs on grade constructed in this manner. Underslab drainage should not be necessary since groundwater is expected to be  $\geq 13$  ft. below the slab.

Three (3) or four (4) retaining walls will be required for grade separation around the Salt Shed & Recycling Depot, depending on the chosen site layout alternative. These walls and their particulars of construction are summarized in the following table. Note that the wall numbers are arbitrary and specific to this report; the actual wall identities may be different.



Wall No.	Location	Length	Exposed Height	Anticipated Bottom of Footing
1	N/NE of Salt Shed	±170 LF	1.5-13 ft.	El. 13.5
2	NW of Salt Shed	±56 LF	3-3.5 ft.	El. 10
3	S of Salt Shed	40 LF (Option 3) 85 LF (Option 4)	1.5-3.5 ft. 1.5-6 ft.	El. 10 El. 8.2
4	SW of Salt Shed	±68 LF (Option 4)	0-3.8 ft.	El. 9.8

Cantilevered cast-in-place concrete walls are recommended for these walls for their durability and longevity. Based on the soils encountered at the applicable boring location, it appears that Wall 1 will be underlain by native sands capable of providing an allowable bearing capacity of 2 tsf following proper compaction of the subgrade. Walls 2, 3, and 4 will be underlain by fill described on the preceding page; these fills should be removed and replaced with structural fill in order to provide an allowable bearing capacity of 2 tsf. Similar to above, a coefficient of base sliding of 0.45 is recommended for design. Following these recommendations, settlement beneath these walls is expected to be <¼ in.

The following in situ soil properties are recommended for design of the retaining wall portions of the building, and the nearby retaining walls:

Moist unit weight of retained soil,	$\gamma_t = 120$ pcf
Angle of internal friction,	$\phi = 28^\circ$
Lateral earth pressure coefficients:	
Active,	$K_a = 0.36$
Passive,	$K_p = 2.77$
At-rest,	$K_o = 0.53$
Coeff. of friction (sliding),	$\tan \delta = 0.45$ (CIP concrete on compacted subgrade)

Settlement beneath the center of the salt pile will be a function of the salt pile height and unit weight. Since the in situ soils are granular settlement and somewhat preloaded in areas due to the presence of fill piles, we anticipate settlement will <1 in. and be elastic, with no long-term settlement occurring.

In accordance with the provisions of Section 1613.3.2 of the New York 2015 Building Code, and ASCE 7 Chapter 20, a seismic site class of D, stiff soil, is recommended for design of the new facilities based on the conditions encountered to a depth of 34 ft. and assumed conditions to a depth of 100 ft. Based on the project location, in conjunction with the above site class, the following seismic parameters follow from the Code:

$S_s = 0.282$	$S_1 = 0.06$
$F_a = 1.575$	$F_v = 2.4$
$S_{MS} = 0.444$	$S_{M1} = 0.144$
$S_{DS} = 0.296$	$S_{D1} = 0.096$

Seismic Design Category = B (Risk Category II)

There is no evidence of past slope instability at this site and none is expected under static or seismic loading of the proposed structures.



The soils at this site are considered non-liquefiable based on the depth to groundwater, relative densities, and/or silt content.

## **CONSTRUCTION RECOMMENDATIONS**

Footings shall not be constructed on frozen or wet subgrade materials. All frozen or saturated subgrade soil should be removed and replaced with compacted structural fill, or clean crushed stone, as required.

The bottom of all footing excavations should be compacted using a minimum of four (4) passes with a vibratory plate, jumping jack, Rammax trench compactor, or similar compactor, and until no further settlement is visible prior to placing structural fill and/or constructing footings.

Footing over-excavations should extend 6 in. on each side for every 12 in. of excavation to provide uniform bearing and minimize differential settlement.

Cobbles and boulders are expected to be encountered during footing excavation and should be removed so that no part protrudes into the bottom or sides of foundation excavations.

Organic soils were only encountered in one (1) sample and are therefore not expected to be encountered in any significant quantity. If organic soils are encountered they should be removed completely from beneath the limits of the buildings and replaced with compacted structural fill. Organic soils should not be used as site or structural backfill, but should be removed offsite.

Dewatering should not be required during construction since groundwater is not expected to be closer than  $\pm 8$  ft. below the bottom of footings. Standard construction sump pits and trash pumps are expected to be able to handle any inflows due to precipitation. Groundwater levels may be influenced by the tides however, and it is plausible that footing subgrades that are excavated in the dry may become saturated later with a rising tide. If softening of footing subgrades is observed, then additional  $\frac{3}{4}$  in. crushed stone or recycle concrete aggregate (RCA) should be placed on the subgrade to prevent such softening.

Compacted structural fill should consist of predominately well-graded, coarse to fine sand and/or gravel with a maximum 10% non-plastic fines (material passing a No. 200 sieve) and be free of organics and other deleterious materials. Aggregate size should be limited to no bigger than 3 in. in the largest dimension. It is estimated that approximately half of the in situ materials may be suitable for use as structural fill, with no moisture sensitive silts anticipated being encountered. Representative samples of any proposed fill material should be tested for gradation and moisture-density relationship prior to use to confirm its suitability.

Structural fill material should be placed in maximum 12 in. loose lifts and compacted to 95% of its maximum dry density at optimum moisture content as determined by the Modified Proctor Density Test (ASTM D1557). These operations should be performed under full-time geotechnical inspection and testing by either the Sand Cone Method (ASTM D1556), Nuclear Density Gauge (ASTM D2922 and D3012), or other moisture/density test methods. These density tests should be performed by an experienced geotechnical inspector at sufficient frequency and spacing to ensure proper compaction, with the following criteria suggested as guidelines:



Location	Frequency of Testing
Structural fill beneath foundations, adjacent to structures & beneath slabs-on-grade	1 test every 2,500 SF min. 1 test per lift
Utility trenches	1 test every 50-100 LF per lift min. 3 tests per day
General site fill (beyond building limits)	1 test every 5,000 SF per lift min. 1 test per lift

For excavations that extend deeper than 5 ft., sheeting, shoring, sloping, or benching of the excavation sidewalls is required per OSHA standards. Depending on the location of the excavation, considering the openness of the site and depth to bedrock, all options are considered viable for consideration. Based on the material characteristics and estimated strength of the soils encountered during the subsurface exploration, the soil present on site should be assumed to be Type C and should be sloped at a 1.5H:1V (34°) per OSHA requirements. For the design of temporary sheeting or shoring, the following range of soil parameters are expected to be appropriate throughout this site, depending on the conditions encountered:

In situ soils

Moist unit weight of soil,  $\gamma_t = 120 \text{ pcf}$

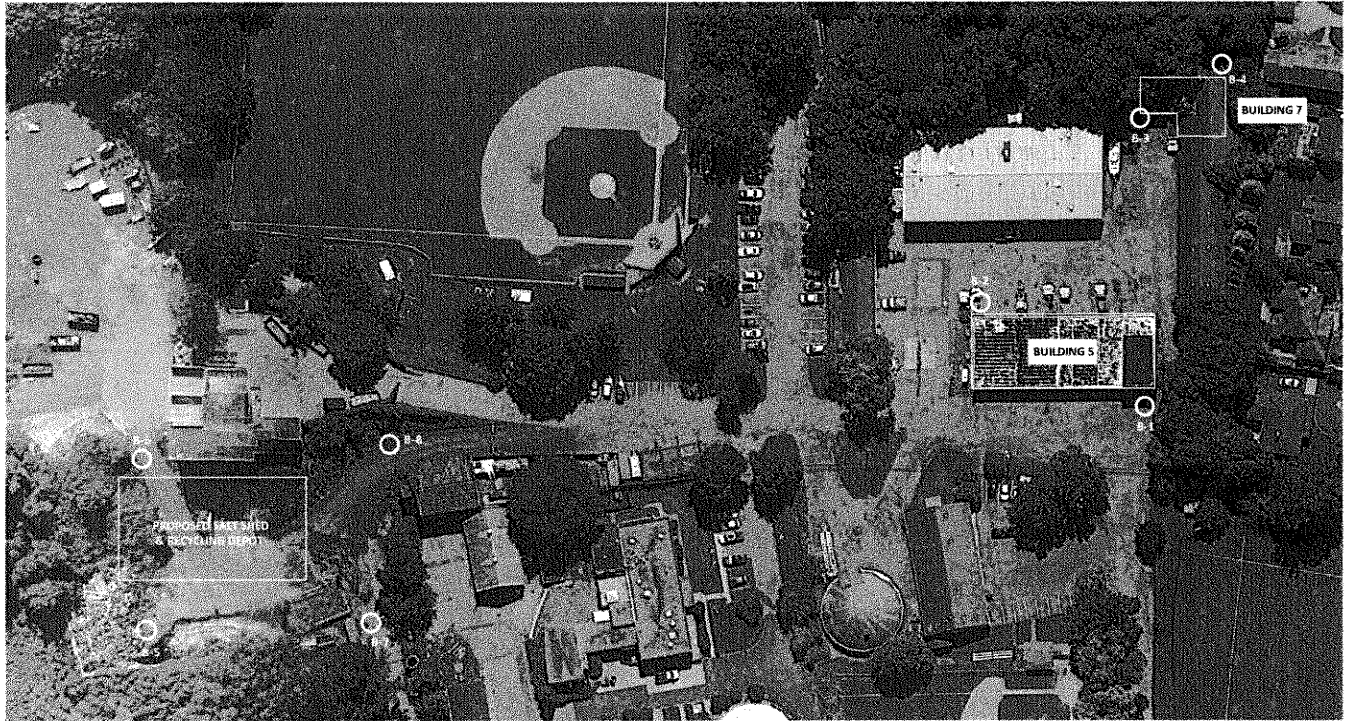
Angle of internal friction,  $\phi = 28^\circ$

All sheeting, shoring and bracing shall be designed by a professional engineer registered in the State of New York. Note that shorter, unbraced excavations will experience localized instability (i.e., sloughing) if left open for more than a day due to the open gradation of the material and expected rapid loss of moisture. To reduce the severity of this sloughing, such excavations should be covered with plastic sheeting for protection from rainfall and moisture changes.

It is recommended that all foundation and subgrade preparation procedures be inspected by a qualified geotechnical engineer experienced with this type of construction.



## **APPENDIX**



**LEGEND**  
 ○ BORING  
 B-1

**SCALE**  
 N.T.S.

**NOTES:**  
 1. BORING LOCATIONS AND SUPPLIED BY SOIL TESTING, INC.  
 2. BASE AERIAL PHOTO © GOOGLE EARTH PRO

**BORING LOCATION PLAN**

**DPW FACILITY IMPROVEMENTS**  
 141 OAKLAND BEACH AVENUE  
 RYE, NEW YORK

**SKYLANDS ENGINEERING, LLC**

124 MILTON ROAD  
 SPARTA, NJ 08757  
 CERTIFICATE OF AUTHORIZATION 0013524

DATE: 2-14-2020



## **Boring Logs**

<b>SOILTESTING, INC.</b> 90 DONOVAN RD. OXFORD, CT 06478 CT (203) 262-9328 NY (914) 946-4850		CLIENT: <u>Stantec Consulting</u>				SHEET <u>1</u> OF <u>1</u>								
		PROJECT NO. <u>G4-1436-19</u>				HOLE NO. <u>B-1 / B-1A</u>								
		PROJECT NAME <u>Sterling Field- Disbrow Park</u>				BORING LOCATIONS per Plan								
FOREMAN - DRILLER <b>MK/ao</b>		LOCATION <b>Rye NY</b>												
INSPECTOR		TYPE SIZE I.D. HAMMER WT. HAMMER FALL				CASING HSA SAMPLER SS CORE BAR 1 3/8" 140# BIT 30"								
GROUND WATER OBSERVATIONS AT <u>none</u> FT AFTER <u>0</u> HOURS AT <u>  </u> FT AFTER <u>  </u> HOURS						OFFSET DATE START <u>1/8/20</u> DATE FINISH <u>1/8/20</u> SURFACE ELEV. <u>EL. ±19'</u> GROUND WATER ELEV.								
DEPTH	CASING BLOWS PER FOOT	SAMPLE						BLOWS PER 6 IN ON SAMPLER (FORCE ON TUBE) 0 - 6 6 - 12 12 - 18	CORE TIME PER FT (MIN)	DENSITY OR CONSIST	STRATA CHANGE DEPTH	FIELD IDENTIFICATION OF SOIL REMARKS INCL. COLOR, LOSS OF WASH WATER, SEAMS IN ROCK, ETC.		
		NO	Type	PEN	REC	DEPTH @ BOT	MOIST						ELEV	
5		1	ss	15"	10"	1'9"	7	14		dry v dense	2'6"	4" Asphalt BlkBrn FM SAND, sm FC gravel, tr cobbles		
10										dry v loose moist v dense wet v dense	3'6"	Auger refusal BOULDER		
15										dry v loose moist v dense wet v dense	6'6"	offset 5' North to B-1A		
20										dry v loose moist v dense wet v dense	7'0"	5" Asphalt BlkBrn FM SAND, sm FC gravel, lit cobbles, boulders (fill)		
25										dry v loose moist v dense wet v dense	7'0"	Brn FMC SAND, tr F gravel (possible fill)		
30										dry v loose moist v dense wet v dense	7'0"	Brn FMC SAND, tr F gravel (possible fill)		
* FROM GOOGLE EARTH														
NOTE: Subsoil conditions revealed by this investigation represent conditions at specific locations and may not represent conditions at other locations or times.														
GROUND SURFACE TO _____ FT. USED _____ CASING THEN _____ CASING TO _____ FT. <span style="float: right;">HOLE NO. <u>B-1 / B-1A</u></span>														
A = AUGER UP = UNDISTURBED PISTON T = THINWALL V = VANE TEST WOR = WEIGHT OF RODS WOH = WEIGHT OF HAMMER & RODS C = COARSE SS = SPLIT TUBE SAMPLER H.S.A. = HOLLOW STEM AUGER M = MEDIUM PROPORTIONS USED: TRACE = 0 - 10% LITTLE = 10 - 20% SOME = 20 - 35% AND = 35 - 50% F = FINE														

<b>SOILTESTING, INC.</b> 90 DONOVAN RD. OXFORD, CT 06478 CT (203) 262-9328 NY (914) 946-4850		CLIENT: <u>Stantec Consulting</u>		SHEET <u>1</u> OF <u>1</u> HOLE NO. <u>B-2</u>	
		PROJECT NO. <u>G4-1436-19</u>			
		PROJECT NAME <u>Sterling Field- Disbrow Park</u>		BORING LOCATIONS per Plan	
FOREMAN - DRILLER <b>MK/ao</b>		LOCATION <u>Rye NY</u>			
INSPECTOR		TYPE <u>HSA</u> <u>SS</u>		OFFSET	
GROUND WATER OBSERVATIONS AT <u>8</u> FT AFTER <u>0</u> HOURS AT <u>  </u> FT AFTER <u>  </u> HOURS		SIZE I.D. <u>3 3/4"</u> <u>1 3/8"</u> HAMMER WT. <u>140#</u> <u>BIT</u> HAMMER FALL <u>30"</u>		DATE START <u>1/8/20</u> DATE FINISH <u>1/8/20</u> SURFACE ELEV. <u>EL ±17*</u> GROUND WATER ELEV. <u>EL ±9</u>	

DEPTH	CASING BLOWS PER FOOT	SAMPLE					BLOWS PER 6 IN ON SAMPLER (FORCE ON TUBE) 0 - 6   6 - 12   12- 18			CORE TIME PER FT (MIN)	DENSITY OR CONSIST	STRATA CHANGE DEPTH	FIELD IDENTIFICATION OF SOIL REMARKS INCL. COLOR, LOSS OF WASH WATER, SEAMS IN ROCK, ETC.	
		NO	Type	PEN	REC	DEPTH @ BOT								
							MOIST	ELEV						
5		1	ss	24"	13"	2'0"	17	27			dry dense	3'6"	4" Asphalt Brn FMC SAND, sm FC gravel No recovery; cobbles 2-3' (possible fill)	
		2	ss	1"	0"	2'1"	50/1"							
		3	ss	24"	14"	5'0"	7	6			dry compact			
							15	18						
		4	ss	24"	18"	7'0"	7	9			dry compact			Brn F SAND, lit FC gravel
10							14	7			compact moist		Brn F SAND, lit FC gravel	
		5	ss	24"	16"	9'0"	7	8			compact wet		Brn FMC SAND, lit FC gravel	
							7	9			compact wet		Brn F SAND, tr silt	
		6	ss	24"	8"	11'0"	5	5			compact wet			
							6	10			loose			
15							3	5						
		8	ss	24"	24"	17'0"	14	9			wet compact		Brn FMC SAND, sm FC gravel	
							5	14						
20												19'0"	SAME	
													Partly weathered BEDROCK or boulders	
		9	ss	3"	3"	20'3"	50/3"				wet	20'6"	Auger refusal	
25														
30														
35														
40														

\* FROM GOOGLE EARTH

**NOTE: Subsoil conditions revealed by this investigation represent conditions at specific locations and may not represent conditions at other locations or times.**

GROUND SURFACE TO _____ FT.	USED _____	CASING _____	THEN _____	CASING TO _____ FT.	HOLE NO. <u>B-2</u>
A = AUGER UP = UNDISTURBED PISTON T = THINWALL V = VANE TEST WOR = WEIGHT OF RODS WOH = WEIGHT OF HAMMER & RODS C = COARSE SS = SPLIT TUBE SAMPLER H.S.A. = HOLLOW STEM AUGER M = MEDIUM PROPORTIONS USED: TRACE = 0 - 10% LITTLE = 10 - 20% SOME = 20 - 35% AND = 35 - 50% F = FINE					

<b>SOILTESTING, INC.</b> 90 DONOVAN RD. OXFORD, CT 06478 CT (203) 262-9328 NY (914) 946-4850		CLIENT: <b>Stantec Consulting</b>				SHEET <u>1</u> OF <u>1</u>					
		PROJECT NO. <b>G4-1436-19</b>				HOLE NO. <b>B-3</b>					
		PROJECT NAME <b>Sterling Field- Disbrow Park</b>				BORING LOCATIONS per Plan					
FOREMAN - DRILLER <b>MK/ao</b>		LOCATION <b>Rye NY</b>									
INSPECTOR		TYPE SIZE I.D. HAMMER WT. HAMMER FALL				CASING HSA SAMPLER SS CORE BAR 140# BIT 30"					
GROUND WATER OBSERVATIONS AT <u>8'</u> FT AFTER <u>0</u> HOURS AT <u>  </u> FT AFTER <u>  </u> HOURS						OFFSET DATE START <b>1/9/20</b> DATE FINISH <b>1/9/20</b> SURFACE ELEV. <b>EL ±23"</b> GROUND WATER ELEV. <b>EL ±15</b>					
DEPTH	CASING BLOWS PER FOOT	SAMPLE					BLOWS PER 6 IN ON SAMPLER (FORCE ON TUBE) 0 - 6 - 6 - 12 - 12 - 18	CORE TIME PER FT (MIN)	DENSITY OR CONSIST	STRATA CHANGE DEPTH	FIELD IDENTIFICATION OF SOIL REMARKS INCL. COLOR, LOSS OF WASH WATER, SEAMS IN ROCK, ETC.
		NO	Type	PEN	REC	DEPTH @ BOT					
5		1	ss	19"	14"	3'7"	7	15	dry dense dry compact dry compact wet compact wet	15'0"	2" Asphalt cobbles to 2" Brn FM SAND, sm FC gravel, tr cobbles  Brn FM SAND, sm FC gravel, tr cobbles  Brn F SAND & SILT  Brn FMC SAND & FC GRAVEL  SAME, tr cobbles
10		2	ss	24"	18"	6'0"	11	8			
15		3	ss	24"	20"	8'0"	11	13			
20		4	ss	24"	18"	10'0"	8	7			
25		5	ss	9"	9"	10'9"	17	50/3"			
30											
35											
40											
* FROM GOOGLE EARTH											
NOTE: Subsoil conditions revealed by this investigation represent conditions at specific locations and may not represent conditions at other locations or times.											
GROUND SURFACE TO <u>      </u> FT. USED <u>      </u> CASING THEN <u>      </u> CASING TO <u>      </u> FT. HOLE NO. <b>B-3</b> A = AUGER UP = UNDISTURBED PISTON T = THINWALL V = VANE TEST WOR = WEIGHT OF RODS WOH = WEIGHT OF HAMMER & RODS C = COARSE SS = SPLIT TUBE SAMPLER H.S.A. = HOLLOW STEM AUGER M = MEDIUM PROPORTIONS USED: TRACE = 0 - 10% LITTLE = 10 - 20% SOME = 20 - 35% AND = 35 - 50% F = FINE											

<b>SOILTESTING, INC.</b> 90 DONOVAN RD. OXFORD, CT 06478 CT (203) 262-9328 NY (914) 946-4850	CLIENT: <b>Stantec Consulting</b>		SHEET <u>1</u> OF <u>1</u> HOLE NO. <b>B-4</b>	
	PROJECT NO. <b>G4-1436-19</b>			
	PROJECT NAME <b>Sterling Field- Disbrow Park</b>		BORING LOCATIONS per Plan	
FOREMAN - DRILLER <b>MK/ao</b>	LOCATION <b>Rye NY</b>			
INSPECTOR	TYPE	CASING HSA	SAMPLER SS	CORE BAR NQ2
GROUND WATER OBSERVATIONS AT <u>none</u> FT AFTER <u>0</u> HOURS AT <u>  </u> FT AFTER <u>  </u> HOURS	SIZE I.D. <b>3 3/4"</b>	<b>1 3/8"</b>	<b>2"</b>	OFFSET DATE START <b>1/8/20</b> DATE FINISH <b>1/8/20</b> SURFACE ELEV. <b>EL ±30*</b> GROUND WATER ELEV.
HAMMER WT. <b>140#</b> HAMMER FALL <b>30"</b>		<b>BIT</b>	<b>dia</b>	

DEPTH	CASING BLOWS PER FOOT	SAMPLE					BLOWS PER 6 IN ON SAMPLER (FORCE ON TUBE) 0 - 6 6 - 12 12 - 18		CORE TIME PER FT (MIN)	DENSITY OR CONSIST	STRATA CHANGE DEPTH	FIELD IDENTIFICATION OF SOIL REMARKS INCL. COLOR, LOSS OF WASH WATER, SEAMS IN ROCK, ETC.
		NO	Type	PEN	REC	DEPTH @ BOT						
5		1	ss	24"	22"	2'0"	5	6		dry		Blk FM SAND & FC GRAVEL
							5	7		compact		
		2	ss	24"	7"	4'0"	5	3		dry		Brn FM SAND, sm FC gravel, tr cobbles
							6	8		loose		
		3	ss	24"	20"	6'0"	20	88		dry		Brn FMC SAND & FC GRAVEL, lit cobbles
10							21	17		v dense		
		4	ss	24"	20"	8'0"	20	28		dry		Brn FM SAND, sm FC gravel, tr silt, lit cobbles
							21	17		dense		
		5	ss	24"	22"	10'0"	9	18		dry		Brn FM SAND, sm FC gravel, tr cobbles
							16	15		dense		
15							16	15		dry		
		7	ss	24"	20"	17'0"	29	48		dry		SAME
							33	36		v dense		
20											18'0"	Auger refusal
		1	C	60"	50"	23'0"	ROD= 63 %		3			
							Rec.= 83%		4			BEDROCK (SCHIST/GNIESS)
									4			
									4			
25									4		23'0"	
30												
35												
40												

**NOTE: Subsoil conditions revealed by this investigation represent conditions at specific locations and may not represent conditions at other locations or times.**

GROUND SURFACE TO _____ FT.	USED _____ CASING	THEN _____ CASING TO _____ FT.	HOLE NO. <b>B-4</b>
A = AUGER UP = UNDISTURBED PISTON T = THINWALL V = VANE TEST WOR = WEIGHT OF RODS WOH = WEIGHT OF HAMMER & RODS C = COARSE SS = SPLIT TUBE SAMPLER H.S.A. = HOLLOW STEM AUGER M = MEDIUM PROPORTIONS USED: TRACE = 0 - 10% LITTLE = 10 - 20% SOME = 20 - 35% AND = 35 - 50% F = FINE			

<b>SOILTESTING, INC.</b> 90 DONOVAN RD. OXFORD, CT 06478 CT (203) 262-9328 NY (914) 946-4850		CLIENT: <b>Stantec Consulting</b>		SHEET <u>1</u> OF <u>1</u>	
		PROJECT NO. <b>G4-1436-19</b>		HOLE NO. <b>B-5</b>  BORING LOCATIONS per Plan	
		PROJECT NAME <b>Sterling Field- Disbrow Park</b>			
FOREMAN - DRILLER <b>MK/ao</b>		LOCATION <b>Rye NY</b>			
INSPECTOR		TYPE <b>HSA</b> CASING <b>SS</b> SIZE I.D. <b>3 3/4"</b> SAMPLER <b>1 3/8"</b> HAMMER WT. <b>140#</b> CORE BAR <b>BIT</b> HAMMER FALL <b>30"</b>		OFFSET	
GROUND WATER OBSERVATIONS				DATE START <b>1/10/20</b>	
AT <u>8'</u> FT AFTER <u>0</u> HOURS				DATE FINISH <b>1/10/20</b>	
AT <u>  </u> FT AFTER <u>  </u> HOURS				SURFACE ELEV. <b>EL ±12</b>	
				GROUND WATER ELEV. <b>EL ±4</b>	

DEPTH	CASING BLOWS PER FOOT	SAMPLE					BLOWS PER 6 IN ON SAMPLER (FORCE ON TUBE)			CORE TIME PER FT (MIN)	DENSITY OR CONSIST	STRATA CHANGE DEPTH	FIELD IDENTIFICATION OF SOIL REMARKS INCL. COLOR, LOSS OF WASH WATER, SEAMS IN ROCK, ETC.
		NO	Type	PEN	REC	DEPTH @ BOT	0-6	6-12	12-18				
5		1	ss	24"	6"	2'0"	21	11			dry	2'0"	2" Asphalt
						11	10			compact	Blk F SAND & FC GRAVEL (possible fill)		
		2	ss	24"	12"	4'0"	17	18			dry		Grey F SAND, lit FC gravel, lit silt
						25	15			dense		Grey F SAND & SILT, tr root fibers	
		3	ss	24"	20"	6'0"	9	5			moist	6'6"	SAME
					4	4			loose				
	4	ss	24"	20"	8'0"	7	15			moist	GreyBrn F SAND, tr F gravel		
					12	11			compact	Grey F SAND, lit silt, tr F gravel			
10		5	ss	24"	20"	10'0"	4	8			moist		
						9	10			compact		Blk F SAND & SILT	
		6	ss	24"	20"	12'0"	8	8			wet	Blk F SAND, tr F gravel	
15						8	8			compact			
		7	ss	24"	12"	17'0"	5	8			wet		Blk F SAND
20						8	6			compact			
		8	ss	24"	18"	22'0"	7	12			wet		Brn F SAND, tr silt
25										compact			
		9	ss	24"	18"	27'0"	5	8			wet		Brn F SAND, tr F gravel
30										compact			
		10	ss	1"	0"	30'1"	50'1"				v dense	31'0"	No recovery      Auger refusal
35													
40													

**NOTE: Subsoil conditions revealed by this investigation represent conditions at specific locations and may not represent conditions at other locations or times.**

GROUND SURFACE TO <u>      </u> FT.	USED <u>      </u> CASING	THEN <u>      </u> CASING TO <u>      </u> FT.	HOLE NO. <b>B-5</b>
A = AUGER    UP = UNDISTURBED PISTON    T = THINWALL    V = VANE TEST WOR = WEIGHT OF RODS    WOH = WEIGHT OF HAMMER & RODS    C = COARSE SS = SPLIT TUBE SAMPLER    H.S.A. = HOLLOW STEM AUGER    M = MEDIUM PROPORTIONS USED: TRACE = 0 - 10%    LITTLE = 10 - 20%    SOME = 20 - 35%    AND = 35 - 50%    F = FINE			

SOILTESTING, INC. 90 DONOVAN RD. OXFORD, CT 06478 CT (203) 262-9328 NY (914) 946-4850								CLIENT: Stantec Consulting				SHEET 1 OF 1 HOLE NO. B-6			
								PROJECT NO. G4-1436-19							
								PROJECT NAME Sterling Field- Disbrow Park				BORING LOCATIONS per Plan			
FOREMAN - DRILLER MK/ao								LOCATION Rye NY							
INSPECTOR												OFFSET			
GROUND WATER OBSERVATIONS								CASING HSA SAMPLER SS CORE BAR NQ2				DATE START 1/10/20			
AT none FT AFTER 0 HOURS								SIZE I.D. 3 3/4" 1 3/8" 2"				DATE FINISH 1/10/20			
AT FT AFTER HOURS								HAMMER WT. 140# BIT				SURFACE ELEV. El. ±28			
								HAMMER FALL 30" dia				GROUND WATER ELEV.			
DEPTH	CASING BLOWS PER FOOT	SAMPLE						BLOWS PER 6 IN ON SAMPLER (FORCE ON TUBE)			CORE TIME PER FT (MIN)	DENSITY OR CONSIST	STRATA CHANGE DEPTH	FIELD IDENTIFICATION OF SOIL REMARKS INCL. COLOR, LOSS OF WASH WATER, SEAMS IN ROCK, ETC.	
		NO	Type	PEN	REC	DEPTH @ BOT	0	6	6	12					12
		1	ss	24"	20"	2'0"	14	18				dry	1'0"	3" Asphalt; 9" gravel	
							10	8				compact		concrete rubble; Blk F SAND, sm silt, lit FC gravel	
		2	ss	24"	16"	4'0"	12	12				dry		Grey F SAND, lit silt, lit FC gravel	
							10	6				compact		Blk F SAND, sm FC gravel, tr silt	
5		3	ss	24"	20"	6'0"	2	3				moist		Blk F SAND, lit FC gravel, glass (fill)	
							2	4				loose			
		4	ss	24"	20"	8'0"	4	3				dry		SAME	
							2	2				loose			
		5	ss	24"	16"	10'0"	5	8				dry	9'0"	Brick, concrete fragments	
10							8	5				compact		Brn FMC SAND, lit FC gravel	
		6	ss	24"	0"	12'0"	8	11				dry		no recovery	
							10	9				compact			
15													14'6"		
		7	ss	1"	1"	15'1"	50/1"						15'6"	cobbles, boulders &/or possible fractured BEDROCK Auger refusal	
		1	C	60"	55"	20'6"	RQD= 53%		4					BEDROCK (SCHIST)	
							Rec = 92%		4						
									4						
20									3						
									3				20'6"		
														E.O.B 20'6"	
25															
30															
35															
40															

**NOTE:** Subsoil conditions revealed by this investigation represent conditions at specific locations and may not represent conditions at other locations or times.

GROUND SURFACE TO \_\_\_\_\_ FT. USED \_\_\_\_\_ CASING THEN \_\_\_\_\_ CASING TO \_\_\_\_\_ FT.      **HOLE NO. B-6**

A = AUGER    UP = UNDISTURBED PISTON                  T = THINWALL                  V = VANE TEST

WOR = WEIGHT OF RODS                  WOH = WEIGHT OF HAMMER & RODS                  C = COARSE

SS = SPLIT TUBE SAMPLER                  H.S.A. = HOLLOW STEM AUGER                  M = MEDIUM

PROPORTIONS USED: TRACE = 0 - 10%    LITTLE = 10 - 20%    SOME = 20 - 35%    AND = 35 - 50%                  F = FINE

<b>SOIL TESTING, INC.</b> 90 DONOVAN RD. OXFORD, CT 06478 CT (203) 262-9328 NY (914) 946-4850	CLIENT:	<b>Stantec Consulting</b>			SHEET <u>1</u> OF <u>1</u>	
	PROJECT NO.	<b>G4-1436-19</b>			HOLE NO. <b>B-7</b>	
	PROJECT NAME	<b>Sterling Field- Disbrow Park</b>			BORING LOCATIONS per Plan	
FOREMAN - DRILLER <b>MK/ao</b>	LOCATION	<b>Rye NY</b>				
INSPECTOR			CASING	SAMPLER	CORE BAR	OFFSET
	TYPE		<b>HSA</b>	<b>SS</b>		DATE START <b>1/9/20</b>
GROUND WATER OBSERVATIONS	SIZE I.D.		<b>3 1/4"</b>	<b>1 3/8"</b>		DATE FINISH <b>1/9/20</b>
AT <u>8</u> FT AFTER <u>0</u> HOURS	HAMMER WT.			<b>140#</b>	<b>BIT</b>	SURFACE ELEV. <b>El. ±10</b>
AT <u>  </u> FT AFTER <u>  </u> HOURS	HAMMER FALL			<b>30"</b>		GROUND WATER ELEV. <b>El. ±2</b>

DEPTH	CASING BLOWS PER FOOT	SAMPLE					BLOWS PER 6 IN ON SAMPLER (FORCE ON TUBE) 0 - 6 6 - 12 12 - 18			CORE TIME PER FT (MIN)	DENSITY OR CONSIST	STRATA CHANGE DEPTH	FIELD IDENTIFICATION OF SOIL REMARKS INCL. COLOR, LOSS OF WASH WATER, SEAMS IN ROCK, ETC.
		NO	Type	PEN	REC.	DEPTH @ BOT					MOIST	ELEV	
5		1	ss	24"	14"	2'0"	12	9			dry		3" Asphalt; BlkBrn F SAND & SILT, tr F gravel
							7	13			compact	1'6"	Blk FC GRAVEL
		2	ss	24"	18"	4'0"	7	3			moist	2'0"	BlkBrn FM SAND, lit silt, tr FC gravel (fill)
							2	2			loose		
		3	ss	24"	10"	6'0"	2	4			moist	4'6"	Brn F SAND, sm silt, tr F gravel (possible fill)
10							7	7			compact		
		4	ss	24"	20"	8'0"	12	7			moist	6'6"	Brn FMC SAND, sm FC gravel
							7	15			compact		GreyBrn F SAND, sm silt
		5	ss	24"	20"	10'0"	5	7			wet		Brn FMC SAND, sm FC gravel
							5	5			compact		
15		6	ss	24"	18"	12'0"	2	3			wet		Brn F SAND, tr F gravel
							4	6			loose		GreyBrn FMC SAND, lit FC gravel
		7	ss	24"	20"	17'0"	5	7			wet		SAME
20							8	8			compact		Brn FMC SAND, lit FC gravel
													SAME
		8	ss	24"	18"	22'0"	4	5			wet		GreyBrn F SAND
25							5	5			loose		
		9	ss	24"	22"	27'0"	6	7			wet		GreyBrn F SAND, tr silt
30							8	14			compact		
		10	ss	24"	22"	32'0"	9	19			wet		GreyBrn FMC SAND lit FC gravel
35							21	23			dense		
												34'0"	Auger refusal
40													

**NOTE: Subsoil conditions revealed by this investigation represent conditions at specific locations and may not represent conditions at other locations or times.**

GROUND SURFACE TO <u>  </u> FT.	USED <u>  </u> CASING	THEN <u>  </u> CASING TO <u>  </u> FT.	HOLE NO. <b>B-7</b>
A = AUGER UP = UNDISTURBED PISTON T = THINWALL V = VANE TEST			
WOR = WEIGHT OF RODS		WOH = WEIGHT OF HAMMER & RODS	C = COARSE
SS = SPLIT TUBE SAMPLER		H.S.A. = HOLLOW STEM AUGER	M = MEDIUM
PROPORTIONS USED: TRACE = 0 - 10% LITTLE = 10 - 20% SOME = 20 - 35% AND = 35 - 50%			F = FINE

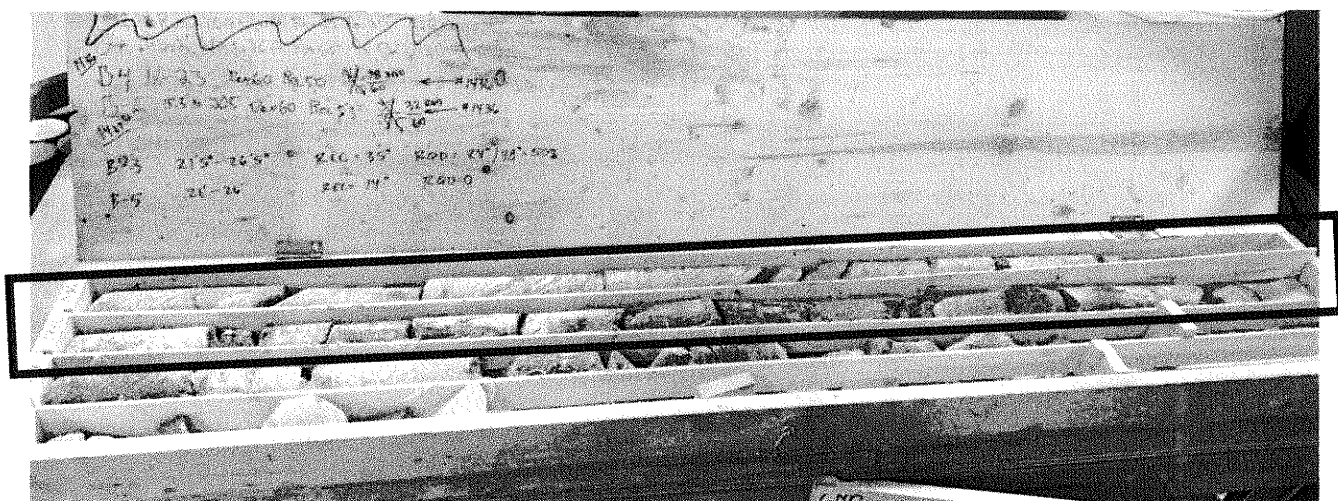


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		PROJECT NO. <b>G4-1436-19</b>		HOLE NO. <b>B-8</b>  BORING LOCATIONS per Plan								
		PROJECT NAME <b>Sterling Field- Disbrow Park</b>										
FOREMAN - DRILLER <b>MK/ao</b>		LOCATION <b>Rye NY</b>		OFFSET DATE START <b>1/9/20</b> DATE FINISH <b>1/9/20</b> SURFACE ELEV. <b>EL. ±20</b> GROUND WATER ELEV.								
INSPECTOR		TYPE <b>HSA</b> CASING <b>SS</b> SIZE I.D. <b>3 3/4"</b> SAMPLER <b>1 3/8"</b> HAMMER WT. <b>140#</b> CORE BAR <b>BIT</b> HAMMER FALL <b>30"</b>										
GROUND WATER OBSERVATIONS AT <u>none</u> FT AFTER <u>0</u> HOURS AT <u>  </u> FT AFTER <u>  </u> HOURS												
DEPTH	CASING BLOWS PER FOOT	SAMPLE					BLOWS PER 6 IN ON SAMPLER (FORCE ON TUBE) 0 - 6 - 12 - 18		CORE TIME PER FT (MIN)	DENSITY OR CONSIST	STRATA CHANGE DEPTH	FIELD IDENTIFICATION OF SOIL REMARKS INCL. COLOR, LOSS OF WASH WATER, SEAMS IN ROCK, ETC.
		NO	Type	PEN	REC	DEPTH @ BOT						
5		1	ss	24"	22"	2'0"	22	12		dry	0'6"	3" Asphalt/ gravel base
		2	ss	24"	20"	4'0"	7	4		compact		Bik FMC SAND & F GRAVEL
							3	3		dry		Brn FM SAND, sm FC gravel, tr silt (possible fill)
							2	1		loose		Brn F SAND, tr F gravel
							4	2		dry		Brn FM SAND, lit FC gravel, tr silt (possible fill)
							3	2		loose		
10							11	9		dry	6'6"	Brn F SAND
							27	44		compact		Brn FMC SAND, sm FC gravel
							28	25		dry		Brn FMC SAND & FC GRAVEL
							36	31		v dense		Brn FMC SAND, sm FC gravel
							50/2"			dry		
										v dense		
15												
20										v dense	16'6"	No recovery Auger refusal
25												
30												
35												
40												

NOTE: Subsoil conditions revealed by this investigation represent conditions at specific locations and may not represent conditions at other locations or times.

GROUND SURFACE TO _____ FT.	USED _____ CASING	THEN _____ CASING TO _____ FT.	HOLE NO. <b>B-8</b>
A = AUGER    UP = UNDISTURBED PISTON    T = THINWALL    V = VANE TEST WOR = WEIGHT OF RODS    WOH = WEIGHT OF HAMMER & RODS    C = COARSE SS = SPLIT TUBE SAMPLER    H.S.A. = HOLLOW STEM AUGER    M = MEDIUM PROPORTIONS USED: TRACE = 0 - 10%    LITTLE = 10 - 20%    SOME = 20 - 35%    AND = 35 - 50%    F = FINE			

## **Rock Core Photo**



Rock Cores - Top Row - B-4 C-1 18-23 ft.  
2<sup>nd</sup> Row - B-6 C-1 15.5-20.5 ft.

## SECTION 011000 - SUMMARY

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Phased construction.
4. Work under Owner's separate contracts.
5. Owner-furnished/Contractor-installed (OFCI) products.
6. Contractor's use of site and premises.
7. Coordination with occupants.
8. Work restrictions.
9. Specification and Drawing conventions.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

#### 1.2 PROJECT INFORMATION

A. Project Identification: DPW Admin Building, Contract No. 2024-10

1. Project Location: 141 Oakland Beach Ave., Rye NY 10580.

B. Owner: City of Rye.

Owner's Representative:  
Eric Kingsbury  
Assistant Superintendent  
Department of Public Works

C. Architect: Stantec Consulting Services, Inc.

Project Manager:  
Michael Geary, PE  
646-784-5620

### 1.3 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and consists of the following:
  - 1. Project consists of the demolition of an existing DPW garage building and the construction of a new, multiuse, garage and administrative office building. Additionally, the project includes new electrical service entrance to the 141 Oakland Ave site in general, and the installation of new photovoltaic solar power systems on the new DPW building and adjacent existing buildings.
- B. Type of Contract:
  - 1. Project will be constructed under four prime contracts.

### 1.4 WORK UNDER SEPARATE CONTRACTS

- A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying Work under this Contract or other contracts. Coordinate the Work of this Contract with work performed under separate contracts.
- B. Concurrent Work: Owner will award separate contract(s) for the following construction operations at Project site. Operations will be conducted simultaneously for work under each Contract.
  - 1. C - General Construction.
  - 2. P – Plumbing and Fire Protection Construction.
  - 3. M - Mechanical Construction.
  - 4. E - Electrical and Photovoltaic Construction.

### 1.5 CONTRACTOR'S USE OF SITE AND PREMISES

- A. Restricted Use of Site: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.
- B. Limits on Use of Site: Limit use of Project site to Work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
  - 1. Limits on Use of Site: Confine construction operations to Work in areas indicated generally inside the proposed construction fence indicated in the plans but including necessary utility and site improvements outside the area to be fenced.
  - 2. Driveways, Walkways, and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.
  - 3. Coordinate limited onsite contractor parking, laydown and storage areas not inside the proposed construction fencing with the Architect/Owner.

- C. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping outside the construction fencing and affected by construction operations throughout construction period. Repair damage caused by construction operations.

#### 1.6 COORDINATION WITH OCCUPANTS

- A. Partial Owner Occupancy: Owner continue to occupy and operate adjacent DPW facilities, throughout the construction of this project. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits unless otherwise indicated.

#### 1.7 WORK RESTRICTIONS

- A. Comply with restrictions on construction operations.
  - 1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Coordinate working hours with the Owner.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
  - 1. Notify Owner not less than two days in advance of proposed utility interruptions.
  - 2. Obtain Owner's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy with Owner.
  - 1. Notify Owner not less than two days in advance of proposed disruptive operations.
  - 2. Obtain Owner's written permission before proceeding with disruptive operations.
- E. Smoking and Controlled Substance Restrictions: Use of tobacco products, alcoholic beverages, and other controlled substances on Owner's property is not permitted.

#### 1.8 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
  - 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
  3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
  4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.
- C. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

## SECTION 011200 - MULTIPLE CONTRACT SUMMARY

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes a summary of each contract, including responsibilities for coordination and temporary facilities and controls.
- B. Related Requirements:
  - 1. Section 011000 "Summary" for the Work covered by the Contract Documents, restrictions on use of Project site, coordination with occupants, and work restrictions.

#### 1.2 DEFINITIONS

- A. Permanent Enclosure: As determined by Architect, the condition at which roofing is insulated and weathertight; exterior walls are insulated and weathertight; and openings are closed with permanent construction or substantial temporary closures equivalent in weather protection to permanent construction.

#### 1.3 PROJECT COORDINATION

- A. Project coordination shall be the mutual responsibility of the four Prime Contracts including the General Construction Contract, Plumbing Contract, Mechanical Contract, and Electrical Contract.
- B. The General Construction Contract is responsible for maintaining a master project schedule that documents the project schedule developed in collaboration by the four Prime Contractors.

#### 1.4 PROJECT COORDINATION RESPONSIBILITIES

- A. The **Four Prime Contractors** shall perform Project coordination activities for the multiple contracts, including, but not limited to, the following:
  - 1. Provide typical overall coordination of the Work.
  - 2. Coordinate shared access to workspaces.
  - 3. Coordinate product selections for compatibility.
  - 4. Provide overall coordination of temporary facilities and controls.
  - 5. Coordinate, schedule, and approve interruptions of permanent and temporary utilities, including those necessary to make connections for temporary services.
  - 6. Coordinate construction and operations of the Work with work performed by each Contract.



7. Prepare coordination drawings in collaboration with each contractor to coordinate work by more than one contract.
  8. Coordinate sequencing and scheduling of the Work.
  9. Each Prime Contractor shall provide photographic documentation of their work in a format common across all four Prime Contracts.
  10. Provide quality-assurance and quality-control services specified in Section 014000 "Quality Requirements."
  11. Coordinate sequence of activities to accommodate tests and inspections, and coordinate schedule of tests and inspections.
  12. Provide information necessary to adjust, move, or relocate existing utility structures affected by construction.
  13. Coordinate cutting and patching.
  14. Coordinate protection of the Work.
  15. Coordinate completion of interrelated punch list items.
- B. The **C - General Construction Contractor** shall perform Project coordination activities for the multiple contracts, including, but not limited to, the following:
1. Maintain a master project schedule that documents the project schedule developed in collaboration by the four Prime Contractors.
  2. Photographic documentation shall be received, maintained and submitted to the Architect by the General Construction Contractor.
  3. The General Construction Contractor shall locate existing permanent benchmarks, control points, and similar reference points, and establish permanent benchmarks on Project site.
  4. The General Construction Contractor shall provide field surveys of in-progress construction and site work.
  5. The General Construction Contractor shall provide progress cleaning of common areas and coordinate progress cleaning of areas or pieces of equipment where more than one contractor has worked.
  6. Print and submit Record Documents if installations by more than one contractor are indicated on the same Contract Drawing or Shop Drawing.
  7. Coordinate preparation of Project Record Documents if information from more than one contractor is to be integrated with information from other contractors to form one combined record.
  8. Collect record Specification Sections from contractors, collate Sections into numeric order, and submit complete set.
  9. Coordinate preparation of operation and maintenance manuals if information from more than one contractor is to be integrated with information from other contractors to form one combined record.
- C. The **C - General Construction Contract** responsibilities for temporary facilities and controls include, but are not limited to, the following:
1. Provide common-use field office for use by all personnel engaged in construction activities.
  2. Provide meeting space for all personnel and a desk with power for each prime contract in the common-use field office.
  3. Provide a single location and drafting table for the review and update of contract documents by each prime contractor.

4. Provide telephone service for common-use facilities.
5. Provide temporary sanitary facilities for use by all personnel engaged in construction activities.

## 1.5 GENERAL REQUIREMENTS OF ALL CONTRACTS

- A. Extent of Contract: Unless the Agreement contains a more specific description of the Work of each Contract, requirements indicated on Drawings and in Specification Sections determine which contract includes a specific element of the Project.
1. Unless otherwise indicated, the work described in this Section for each contract shall be complete systems and assemblies, including products, components, accessories, and installation required by the Contract Documents.
  2. Trenches and other excavation for the work of each contract shall be the work of each contract for its own work.
  3. Blocking, backing panels, sleeves, and metal fabrication supports for the work of each contract shall be the work of each contract for its own work.
  4. Furnishing of access panels for the work of each contract shall be the work of each contract for its own work. Installation of access panels shall be the work of each contract for its own work.
  5. Equipment pads for the work of each contract shall be the work of each contract for its own work.
  6. Roof-mounted equipment curbs for the work of each contract shall be the work of each contract for its own work.
  7. Painting for the work of each contract shall be the work of the General Construction Contract.
  8. Cutting and Patching: Provided under each contract for its own work.
  9. Contractors' Startup Construction Schedule: Within ten working days after startup, the four Prime Contractors shall develop a single coordinated horizontal bar-chart-type construction schedule, showing construction operations sequenced and coordinated with overall construction. The General Construction Contract shall submit the schedule to the Architect for review and incorporate updates provided by each Prime Contractor monthly.
- B. Substitutions: Each contractor shall cooperate with other contractors involved to coordinate approved substitutions with remainder of the work.
1. The four Prime Contractors shall coordinate substitutions.
- C. Temporary Facilities and Controls: In addition to specific responsibilities for temporary facilities and controls indicated in this Section and in Section 015000 "Temporary Facilities and Controls," each contractor is responsible for the following:
1. Installation, operation, maintenance, and removal of each temporary facility necessary for its own normal construction activity, and costs and use charges associated with each facility, except as otherwise provided for in this Section.
  2. Plug-in electric power cords and extension cords, supplementary plug-in task lighting, and special lighting necessary exclusively for its own activities.

3. Its own storage.
  4. Temporary enclosures for its own construction activities.
  5. Staging and scaffolding for its own construction activities.
  6. General hoisting facilities for its own construction activities.
  7. Waste disposal facilities, including collection and legal disposal of its own hazardous, dangerous, unsanitary, or other harmful waste materials.
  8. Progress cleaning of work areas affected by its operations daily.
  9. Secure lockup of its own tools, materials, and equipment.
  10. Construction aids and miscellaneous services and facilities necessary exclusively for its own construction activities.
- D. Temporary Heating, Cooling, and Ventilation Systems: The **M - Mechanical Contract** is responsible for temporary heating, cooling, and ventilation, temporary meters, and temporary connections.
- E. Sanitary: Comply with the following:
1. Sewer Service: The Contracts shall not dispose of waste in nor use the sanitary sewer except for testing of completed systems.

#### 1.6 GENERAL CONSTRUCTION CONTRACT - C

- A. Work of the General Construction Contract includes, but is not limited to, the following:
1. Remaining work not identified as work under other contracts.
  2. Work defined on Drawings:
    - a. Title Sheet
    - b. Life Safety – G-002
    - c. Civil – C Series
    - d. Structural – S Series
    - e. Architecture – A Series
  3. Work defined in Specifications:
    - a. Division 00
    - b. Division 01
    - c. Divisions 02 – 13
    - d. Division 31 - 33 Sections
- B. Temporary facilities and controls in the General Construction Contract are specified in Section 015000 “Temporary Facilities and Controls”.
1. Temporary facilities and controls that are not otherwise specifically assigned to the Plumbing Contract, Mechanical Contract, or Electrical Contract shall be provided by the General Contract.

#### 1.7 PLUMBING CONTRACT - P

- A. Work of the Plumbing Contract includes, but is not limited to, the following:

1. Plumbing connections to equipment furnished by the General Construction Contract, Plumbing Contract, Mechanical Contract, and Owner.
  2. Fire Protection system
  3. Drawings.
    - a. Title Sheet
    - b. Life Safety – G-002
    - c. Plumbing – P Series
    - d. Fire Protection – FP Series
  4. Specifications.
    - a. Division 00
    - b. Division 01
    - c. Division 21
    - d. Division 22
- B. Temporary facilities and controls in the Plumbing Contract are specified in Section 015000 “Temporary Facilities and Controls”.

#### 1.8 MECHANICAL CONTRACT - M

- A. Work of the Mechanical Contract includes, but is not limited to, the following:
1. Drawings.
    - a. Title Sheet
    - b. Life Safety – G-002
    - c. Mechanical – M Series
  2. Specifications.
    - a. Division 00
    - b. Division 01
    - c. Division 23
    - d. Section 089119 related to Division 23
- B. Temporary facilities and controls in the Mechanical Contract are specified in Section 015000 “Temporary Facilities and Controls”.

#### 1.9 ELECTRICAL CONTRACT - E

- A. Work of the Electrical Contract includes, but is not limited to, the following:
1. Electrical connections to equipment furnished by the General Construction Contract, Plumbing Contract, Mechanical Contract, Electrical Contract.
  2. Drawings.
    - a. Title Sheet
    - b. Life Safety – G-002
    - c. Electrical – E Series
    - d. Solar Photovoltaic Installation – PV Series
  3. Specifications.
    - a. Division 00
    - b. Division 01

- c. Division 08 Section 087111 electrical power for electronic hardware, final hardware connections by GC.
  - d. Division 26 - 28
  - e. Division 03, Section 033000 Cast-in-Place Concrete for contract related work including equipment pads.
  - f. Division 31 – Earthwork for contract related work.
- B. Temporary facilities and controls in the Electrical Contract are specified in Section 015000 “Temporary Facilities and Controls” and shall include the following:
  - 1. Electrical connections to existing systems and temporary facilities and controls furnished by the General Construction Contract, Plumbing Contract, Mechanical Contract, and Electrical Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011200

## SECTION 012100 - ALLOWANCES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements governing allowances.
- B. Purpose of Allowance: To establish a predetermined amount in each prime contract for owner's use for contract scope changes.

#### 1.2 SUBMITTALS

- A. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

#### 1.3 CONTINGENCY ALLOWANCES

- A. Use the contingency allowance only as directed by Architect for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.
- B. Change Orders authorizing use of funds from the contingency allowance will include Contractor's related costs and reasonable overhead and profit.
- C. Prior to Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.

### PART 2 - PRODUCTS (Not Used)

### PART 3 - EXECUTION

#### 3.1 SCHEDULE OF ALLOWANCES

- A. Allowance No. GC1: Contingency Allowance
  - 1. Contract affected by this section: C- General Construction
  - 2. Include in Bid Price an Allowance of \$250,000 to be used at Owner's discretion for contract scope changes.
- B. Allowance No. PC1: Contingency Allowance
  - 1. Contract affected by this section: P- Plumbing and Fire Protection
  - 2. Include in Bid Price an Allowance of \$75,000 to be used at Owner's discretion for contract scope changes

- C. Allowance No. MC1: Contingency Allowance
  - 1. Contract affected by this section: M- Mechanical
  - 2. Include in Bid Price an Allowance of \$75,000 to be used at Owner's discretion for contract scope changes
  
- D. Allowance No. EC1: Contingency Allowance
  - 1. Contract affected by this section: E- Electrical
  - 2. Include in Bid Price an Allowance of \$100,000 to be used at Owner's discretion for contract scope changes

END OF SECTION 012100

## SECTION 012500 - SUBSTITUTION PROCEDURES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
  - 1. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

#### 1.2 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
  - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
  - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

#### 1.3 ACTION SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
  - 1. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
    - a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
    - b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
    - c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.



- d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
  - e. Samples, where applicable or requested.
  - f. Certificates and qualification data, where applicable or requested.
  - g. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
  - h. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
  - i. Cost information, including a proposal of change, if any, in the Contract Sum.
  - j. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
  - k. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
  - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

#### 1.4 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

#### 1.5 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

## 1.6 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
    - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
    - b. Substitution request is fully documented and properly submitted.
    - c. Requested substitution will not adversely affect Contractor's construction schedule.
    - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
    - e. Requested substitution is compatible with other portions of the Work.
    - f. Requested substitution has been coordinated with other portions of the Work.
    - g. Requested substitution provides specified warranty.
    - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- B. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 days after commencement of the Work. Requests received after that time may be considered or rejected at discretion of Architect.
1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
    - a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
    - b. Requested substitution does not require extensive revisions to the Contract Documents.
    - c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
    - d. Substitution request is fully documented and properly submitted.
    - e. Requested substitution will not adversely affect Contractor's construction schedule.
    - f. Requested substitution has received necessary approvals of authorities having jurisdiction.
    - g. Requested substitution is compatible with other portions of the Work.
    - h. Requested substitution has been coordinated with other portions of the Work.
    - i. Requested substitution provides specified warranty.

- j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

## SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

#### 1.2 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time.
  - 1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.

#### 1.3 PROPOSAL REQUESTS

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

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.

#### 1.4 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Change Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor.

#### 1.5 CONSTRUCTION CHANGE DIRECTIVE

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

## SECTION 012900 - PAYMENT PROCEDURES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

#### 1.2 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
  - 1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
  - 2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
  - 1. Arrange schedule of values consistent with format of AIA Document G703.
  - 2. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
  - 3. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
    - a. Differentiate between items stored on-site and items stored off-site.
  - 4. Overhead Costs: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
  - 5. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
  - 6. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

#### 1.3 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.

- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Payment Application Times: Submit Application for Payment to Architect by the seventh day of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.
  - 1. Submit draft copy of Application for Payment seven days prior to due date for review by Architect.
- D. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
- E. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
  - 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
  - 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
  - 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
- F. Transmittal: Submit one signed and notarized original copy of each Application for Payment to Architect by a method ensuring receipt. Copy shall include waivers of lien and similar attachments if required.
  - 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
  - 1. List of subcontractors.
  - 2. Schedule of values.
  - 3. Contractor's construction schedule (preliminary if not final).
  - 4. Products list (preliminary if not final).
  - 5. Submittal schedule (preliminary if not final).
  - 6. List of Contractor's staff assignments.
  - 7. List of Contractor's principal consultants.
  - 8. Copies of building permits.
  - 9. Certificates of insurance and insurance policies.
  - 10. Performance and payment bonds.

- H. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
  - 1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
  - 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- I. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
  - 1. Evidence of completion of Project closeout requirements.
  - 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
  - 3. Updated final statement, accounting for final changes to the Contract Sum.
  - 4. AIA Document G706.
  - 5. AIA Document G706A.
  - 6. AIA Document G707.
  - 7. Evidence that claims have been settled.
  - 8. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900



## SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
  - 1. Coordination drawings.
  - 2. RFIs.
  - 3. Digital project management procedures.
  - 4. Project meetings.
- B. Related Requirements:
  - 1. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.

#### 1.2 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
  - 1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
  - 2. Number and title of related Specification Section(s) covered by subcontract.

#### 1.3 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
  - 1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
    - a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.

- b. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
2. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
3. Review: Architect will review coordination drawings to confirm that, in general, the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make suitable modifications and resubmit.

#### 1.4 REQUEST FOR INFORMATION (RFI)

- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
  1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
  2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
  1. Owner name.
  2. Owner's Project number.
  3. Name of Architect.
  4. Date.
  5. Name of Contractor.
  6. RFI number, numbered sequentially.
  7. RFI subject.
  8. Specification Section number and title and related paragraphs, as appropriate.
  9. Drawing number and detail references, as appropriate.
  10. Field dimensions and conditions, as appropriate.
  11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
  12. Contractor's signature.
  13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
- C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.

- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow five days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.

1. The following Contractor-generated RFIs will be returned without action:
  - a. Requests for approval of submittals.
  - b. Requests for approval of substitutions.
  - c. Requests for approval of Contractor's means and methods.
  - d. Requests for coordination information already indicated in the Contract Documents.
  - e. Requests for adjustments in the Contract Time or the Contract Sum.
  - f. Requests for interpretation of Architect's actions on submittals.
  - g. Incomplete RFIs or inaccurately prepared RFIs.
2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect of additional information.
3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."
  - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within five days of receipt of the RFI response.

- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log bi-weekly.

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

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

## 1.5 DIGITAL PROJECT MANAGEMENT PROCEDURES

- A. Use of Architect's Digital Data Files: Project digital data files can be provided by Architect for Contractor's use during construction upon written request.

1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project record Drawings.

2. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
3. Digital Drawing Software Program: digital files will be provided in .dwg file format
4. Contractor shall execute a data licensing agreement in the form of Agreement provided by the Architect.
  - a. Subcontractors, and other parties granted access by Contractor to Architect's digital data files shall execute a data licensing agreement in the form of Agreement provided by the Architect.

B. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.

## 1.6 PROJECT MEETINGS

A. General: **C – General Construction Contract** schedule and conduct meetings and conferences at Project site unless otherwise indicated.

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

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

- o. Use of the premises.
    - p. Work restrictions.
    - q. Working hours.
    - r. Owner's occupancy requirements.
    - s. Responsibility for temporary facilities and controls.
    - t. Procedures for moisture and mold control.
    - u. Procedures for disruptions and shutdowns.
    - v. Construction waste management and recycling.
    - w. Parking availability.
    - x. Office, work, and storage areas.
    - y. Equipment deliveries and priorities.
    - z. First aid.
    - aa. Security.
    - bb. Progress cleaning.
  - 3. Minutes: **C – General Construction Contract.** Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Progress Meetings: **C – General Construction Contract** Conduct progress meetings at biweekly intervals.
- 1. Coordinate dates of meetings with preparation of payment requests.
  - 2. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
  - 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
    - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
      - 1) Review schedule for next period.
    - b. Review present and future needs of each entity present, including the following:
      - 1) Interface requirements.
      - 2) Sequence of operations.
      - 3) Status of submittals.
      - 4) Deliveries.
      - 5) Access.
      - 6) Site use.
      - 7) Temporary facilities and controls.

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

## SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

### PART 1 - GENERAL – **ALL PRIME CONTRACTS**

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
  - 1. Daily construction reports.
  - 2. Site condition reports.

#### 1.2 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
  - 1. PDF file.
- B. Daily Construction Reports: Submit at monthly intervals.
- C. Site Condition Reports: Submit at time of discovery of differing conditions.
- D. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
  - 1. Unresolved issues.
  - 2. Unanswered Requests for Information.
  - 3. Rejected or unreturned submittals.
  - 4. Notations on returned submittals.
  - 5. Pending modifications affecting the Work and the Contract Time.

#### 1.3 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
  - 1. List of subcontractors at Project site.
  - 2. List of separate contractors at Project site.
  - 3. Approximate count of personnel at Project site.
  - 4. Equipment at Project site.
  - 5. Material deliveries.
  - 6. High and low temperatures and general weather conditions, including presence of rain or snow.
  - 7. Testing and inspection.
  - 8. Accidents.

9. Meetings and significant decisions.
10. Stoppages, delays, shortages, and losses.
11. Meter readings and similar recordings.
12. Emergency procedures.
13. Orders and requests of authorities having jurisdiction.
14. Change Orders received and implemented.
15. Construction Change Directives received and implemented.
16. Services connected and disconnected.
17. Equipment or system tests and startups.
18. Partial completions and occupancies.
19. Substantial Completions authorized.

- B. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013200



## SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

### PART 1 - GENERAL – **ALL PRIME CONTRACTS**

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
  - 1. Preconstruction photographs.
  - 2. Concealed Work photographs.
  - 3. Periodic construction photographs.
  - 4. Final completion construction photographs.
- B. Related Requirements:
  - 1. Section 017700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.

#### 1.2 INFORMATIONAL SUBMITTALS

- A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.
- B. Digital Photographs: Submit image files within five days of taking photographs.
  - 1. Submit photos by uploading to web-based Project management software site. Include copy of key plan indicating each photograph's location and direction.
  - 2. Identification: Provide the following information with each image description:
    - a. Name of Project.
    - b. Name of Contractor.
    - c. Date photograph was taken.
    - d. Description of location, vantage point, and direction.
    - e. Unique sequential identifier keyed to accompanying key plan.

#### 1.3 FORMATS AND MEDIA

- A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of 2 megapixels, and at an image resolution of not less than 3200 by 2400 pixels. Use flash in low light levels or backlit conditions.
- B. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.

- C. File Names: Name media files with date and sequential numbering suffix.

#### 1.4 CONSTRUCTION PHOTOGRAPHS

- A. General: Take photographs with maximum depth of field and in focus.
  - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- B. Preconstruction Photographs: Before commencement of the Work, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points.
  - 1. Flag excavation areas before taking construction photographs.
  - 2. Take 20 photographs to show existing conditions before starting the Work.
- C. Concealed Work Photographs: Before proceeding with installing work that will conceal other work, take photographs sufficient in number, with annotated descriptions, to record nature and location of concealed Work, including, but not limited to, the following:
  - 1. Underground utilities.
  - 2. Underslab services.
  - 3. Piping.
  - 4. Electrical conduit.
  - 5. Waterproofing and weather-resistant barriers.
- D. Periodic Construction Photographs: Take 20 photographs weekly. Select vantage points to show status of construction and progress since last photographs were taken.
- E. Final Completion Construction Photographs: Take 20 photographs after date of Substantial Completion for submission as Project Record Documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013233

## SECTION 013300 - SUBMITTAL PROCEDURES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

#### 1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

#### 1.3 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

#### 1.4 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Architect.
4. Name of Contractor.
5. Name of firm or entity that prepared submittal.
6. Names of subcontractor, manufacturer, and supplier.
7. Category and type of submittal.
8. Submittal purpose and description.

9. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
  10. Drawing number and detail references, as appropriate.
  11. Indication of full or partial submittal.
  12. Location(s) where product is to be installed, as appropriate.
  13. Other necessary identification.
  14. Remarks.
  15. Signature of transmitter.
- B. Options: Identify options requiring selection by Architect.
- C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
- D. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

## 1.5 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
1. Email: Prepare submittals as PDF package, and transmit to Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
  2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
  3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 10 business days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
  2. Resubmittal Review: Allow 10 business days for review of each resubmittal.

- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

## 1.6 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
  - 1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
  - 2. Mark each copy of each submittal to show which products and options are applicable.
  - 3. Include the following information, as applicable:
    - a. Manufacturer's catalog cuts.
    - b. Manufacturer's product specifications.
    - c. Standard color charts.
    - d. Statement of compliance with specified referenced standards.
    - e. Testing by recognized testing agency.
    - f. Application of testing agency labels and seals.
    - g. Notation of coordination requirements.
    - h. Availability and delivery time information.
  - 4. For equipment, include the following in addition to the above, as applicable:
    - a. Wiring diagrams that show factory-installed wiring.
    - b. Printed performance curves.
    - c. Operational range diagrams.
    - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
  - 5. Submit Product Data before Shop Drawings, and before or concurrent with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
  - 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    - a. Identification of products.
    - b. Schedules.
    - c. Compliance with specified standards.
    - d. Notation of coordination requirements.

- e. Notation of dimensions established by field measurement.
  - f. Relationship and attachment to adjoining construction clearly indicated.
  - g. Seal and signature of professional engineer if specified.
- C. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other materials.
- 1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
  - 2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
    - a. Project name and submittal number.
    - b. Generic description of Sample.
    - c. Product name and name of manufacturer.
    - d. Sample source.
    - e. Number and title of applicable Specification Section.
    - f. Specification paragraph number and generic name of each item.
  - 3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics, and identification information for record.
  - 4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
    - a. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
  - 5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
    - a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
  - 6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
    - a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.

- 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
  - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.
- G. Certificates:
  1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
  2. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
  3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
  4. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
  5. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
  6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- H. Test and Research Reports:
  1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.

2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
  - a. Name of evaluation organization.
  - b. Date of evaluation.
  - c. Time period when report is in effect.
  - d. Product and manufacturers' names.
  - e. Description of product.
  - f. Test procedures and results.
  - g. Limitations of use.

#### 1.7 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
  1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file and three paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
  1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.



1.8 CONTRACTOR'S REVIEW

- A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
  - 1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

1.9 ARCHITECT'S REVIEW

- A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return it.
  - 1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action.
- B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Architect will discard submittals received from sources other than Contractor.
- F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013300

## SECTION 014000 - QUALITY REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
  - 1. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
  - 2. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

#### 1.2 DEFINITIONS

- A. Experienced: When used with an entity or individual, "experienced" unless otherwise further described means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
  - 1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).
- D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.
- E. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency

qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

- F. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source; for example, plant, mill, factory, or shop.
- G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall have the same meaning as testing agency.
- H. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- I. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect.

### 1.3 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
  - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Services Statement: Submit a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

### 1.4 CONFLICTING REQUIREMENTS

- A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as

appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:
  - 1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
  - 2. Main wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.
- B. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- C. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

## 1.6 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
  - 1. Date of issue.
  - 2. Project title and number.
  - 3. Name, address, telephone number, and email address of testing agency.
  - 4. Dates and locations of samples and tests or inspections.
  - 5. Names of individuals making tests and inspections.
  - 6. Description of the Work and test and inspection method.
  - 7. Identification of product and Specification Section.
  - 8. Complete test or inspection data.
  - 9. Test and inspection results and an interpretation of test results.
  - 10. Record of temperature and weather conditions at time of sample taking and testing and inspection.
  - 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
  - 12. Name and signature of laboratory inspector.
  - 13. Recommendations on retesting and re-inspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Statement on condition of substrates and their acceptability for installation of product.
  2. Statement that products at Project site comply with requirements.
  3. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
  4. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  5. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Statement that equipment complies with requirements.
  2. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  3. Other required items indicated in individual Specification Sections.

#### 1.7 QUALITY ASSURANCE

- A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.
- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

- G. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented according to ASTM E329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
  - 1. Contractor responsibilities include the following:
    - a. Provide test specimens representative of proposed products and construction.
    - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
    - c. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
    - d. When testing is complete, remove test specimens and test assemblies, and mockups; do not reuse products on Project.
  - 2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

## 1.8 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
  - 1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
  - 2. Costs for retesting and re-inspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
  - 1. Engage a qualified testing agency to perform quality-control services.

- a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
  2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
  3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
  4. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
  5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Retesting/Re-inspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and re-inspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- D. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
  2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
  3. Conduct and interpret tests and inspections and state in each report whether tested and inspected Work complies with or deviates from requirements.
  4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
  5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
  6. Do not perform duties of Contractor.
- E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."
- F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- G. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
  2. Incidental labor and facilities necessary to facilitate tests and inspections.

3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Preliminary design mix proposed for use for material mixes that require control by testing agency.
6. Security and protection for samples and for testing and inspection equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

#### 1.9 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, as indicated in the Statement of Special Inspections attached to this Section, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and re-inspecting corrected Work.

#### PART 2 - PRODUCTS (Not Used)

#### PART 3 - EXECUTION

##### 3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.



- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's and authorities' having jurisdiction reference during normal working hours.

- 1. Submit log at Project closeout as part of Project Record Documents.

### 3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspection, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
  - 1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching.
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

## SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

### PART 1 - GENERAL – **All Contracts**

#### 1.1 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
  - 1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

#### 1.2 USE CHARGES

- A. Installation, removal, and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Architect, testing agencies, and authorities having jurisdiction.
- B. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- C. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.
- B. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.
- C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- D. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold. Describe delivery, handling,

storage, installation, and protection provisions for materials subject to water absorption or water damage.

1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and requirements for replacing water-damaged Work.
2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
3. Indicate methods to be used to avoid trapping water in finished work.

#### 1.4 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

#### 1.5 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

### PART 2 - PRODUCTS

#### 2.1 TEMPORARY FACILITIES

- A. Field Offices: **G-Contract**, prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: **G-Contract**, of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:
  1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
  2. Conference room of sufficient size to accommodate meetings of 12 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot- square tack and marker boards.

3. Drinking water and sanitary facilities (may be porta johns).
4. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
5. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.

## 2.2 EQUIPMENT

- A. Fire Extinguishers: **G-Contract**, portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: **H-Contract**, unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas with individual space thermostatic control.
  1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
  2. Heating, Cooling, and Dehumidifying Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction and marked for intended location and application.

## PART 3 - EXECUTION

### 3.1 TEMPORARY FACILITIES, GENERAL – **All Contracts**

- A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

### 3.2 INSTALLATION, GENERAL – **All Contracts**

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

### 3.3 TEMPORARY UTILITY INSTALLATION

- A. General: – **All Contracts**, install temporary service or connect to existing service.
  1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Storm Sewers: **G-Contract**, provide temporary utilities to remove effluent lawfully.

1. Connect temporary storm sewers to municipal system as directed by authorities having jurisdiction.
- C. Water Service: **P-Contract**, install water service and distribution piping in sizes and pressures adequate for construction.
- D. Sanitary Facilities: **G-Contract**, provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities. Effluent shall be stored in tanks and removed from the site by the contractor and disposed of lawfully.
- E. Temporary Heating and Cooling: **H-Contract**, provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- F. Electric Power Service: **E-Contract**, provide temporary electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
  1. Install electric power service overhead unless otherwise indicated.
- G. Lighting: **E-Contract**, provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
  1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- H. Electronic Communication Service: **G-Contract**, provide secure WiFi wireless connection to internet with provisions for access by Architect and Owner.

#### 3.4 SUPPORT FACILITIES INSTALLATION

- A. Temporary Roads and Paved Areas: **G-Contract**, construct and maintain temporary roads adequate for construction operations. Locate temporary roads and paved areas as indicated on Drawings.
  1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.
- B. Traffic Controls: **All Contracts**, comply with requirements of authorities having jurisdiction.
  1. Protect existing site improvements to remain including curbs, pavement, and utilities.
  2. Maintain access for fire-fighting equipment and access to fire hydrants.

- C. Parking: **All Contracts**, use designated areas of Owner's existing parking areas for construction personnel.
- D. Storage and Staging: **All Contracts**, use designated areas of Project site for storage and staging needs.
- E. Dewatering Facilities and Drains: **G-Contract**, comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
  - 1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
  - 2. Remove snow and ice as required to minimize accumulations.
- F. Project Signs: **G-Contract**, provide Project signs as indicated. **All Contracts**, unauthorized signs are not permitted.
  - 1. Identification Signs: Provide Project identification signs as indicated on Drawings.
  - 2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
    - a. Provide temporary, directional signs for construction personnel and visitors.
  - 3. Maintain and touch up signs so they are legible at all times.
- G. Waste Disposal Facilities: **G-Contract**, provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."
- H. Lifts and Hoists: **All Contracts**, provide facilities necessary for hoisting materials and personnel for their respective work.

### 3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: **All Contracts**, protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
  - 1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.
- B. Environmental Protection: **All Contracts**, provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
- C. Temporary Erosion and Sedimentation Control: **G-Contract**, comply with requirements specified in Section 311000 "Site Clearing & Erosion Control."

- D. Stormwater Control: **G-Contract**, comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- E. Tree and Plant Protection: **G-Contract**, comply with requirements specified in Section 015639 "Temporary Tree and Plant Protection."
- F. Site Enclosure Fence: **G-Contract**, prior to commencing earthwork, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.
  - 1. Extent of Fence: As indicated on Drawings.
  - 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel.
- G. Security Enclosure and Lockup: **G-Contract**, install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.
- H. Barricades, Warning Signs, and Lights: **All Contracts**, comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- I. Temporary Enclosures: **G-Contract**, provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
  - 1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.
- J. Temporary Fire Protection: **All Contracts**, Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
  - 1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
  - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
  - 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

### 3.6 MOISTURE AND MOLD CONTROL – **All Contracts**

- A. Moisture and Mold Protection: Protect stored materials and installed Work in accordance with Moisture and Mold Protection Plan.

- B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
  - 1. Protect porous materials from water damage.
  - 2. Protect stored and installed material from flowing or standing water.
  - 3. Keep porous and organic materials from coming into prolonged contact with concrete.
  - 4. Remove standing water from decks.
  - 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
  - 1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
  - 2. Keep interior spaces reasonably clean and protected from water damage.
  - 3. Periodically collect and remove waste containing cellulose or other organic matter.
  - 4. Discard or replace water-damaged material.
  - 5. Do not install material that is wet.
  - 6. Discard and replace stored or installed material that begins to grow mold.
  - 7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.
- D. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
  - 1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
  - 2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
  - 3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.

### 3.7 OPERATION, TERMINATION, AND REMOVAL - All Contracts

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
  - 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial



Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

## SECTION 016000 - PRODUCT REQUIREMENTS

### PART 1 - GENERAL – **All Contracts**

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
  - 1. Section 012500 "Substitution Procedures" for requests for substitutions.

#### 1.2 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
  - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
  - 2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products, unless indicated otherwise.
  - 3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.
  - 1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification.

- C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.
- D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:
  - 1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
  - 2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.
- E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 013300 "Submittal Procedures."
- F. Substitution: Refer to Section 012500 "Substitution Procedures" for definition and limitations on substitutions.

### 1.3 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

### 1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

### 1.5 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
  - 1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.

2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
  2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
  3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

## PART 2 - PRODUCTS

### 2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
  2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
  3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
  4. Where products are accompanied by the term "as selected," Architect will make selection.
- B. Product Selection Procedures:
1. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed or an unnamed product that complies with requirements.
    - a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
    - b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.
  2. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed or a product by an unnamed manufacturer that complies with requirements.

- a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
  - b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.
3. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
  - a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.
- C. Visual Matching Specification: Where Specifications require the phrase "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
  1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

## 2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with the following requirements:
  1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
  2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes, such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
  3. Evidence that proposed product provides specified warranty.
  4. List of similar installations for completed projects, with project names and addresses and names and addresses of architects and owners, if requested.
  5. Samples, if requested.

- B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation, as specified in Section 013300 "Submittal Procedures."
  - 1. Form of Approval of Submittal: As specified in Section 013300 "Submittal Procedures."
  - 2. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- C. Submittal Requirements, Two-Step Process: Approval by the Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

## SECTION 017300 - EXECUTION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:
  - 1. Construction layout.
  - 2. Field engineering and surveying.
  - 3. Installation of the Work.
  - 4. Cutting and patching.
  - 5. Coordination of Owner's portion of the Work.
  - 6. Coordination of Owner-installed products.
  - 7. Progress cleaning.
  - 8. Starting and adjusting.
  - 9. Protection of installed construction.
- B. Related Requirements:
  - 1. Section 011000 "Summary" for coordination of, Owner's separate contracts, and limits on use of Project site.

#### 1.2 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

#### 1.3 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
  - 1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from

- Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
  3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
  4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
- C. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

## PART 3 - EXECUTION

### 3.1 EXAMINATION – All Contracts

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, and other construction affecting the Work.
  1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.



2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
  1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
  2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
  3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

### **3.2 PREPARATION – All Contracts**

- A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect in accordance with requirements in Section 013100 "Project Management and Coordination."

### **3.3 CONSTRUCTION LAYOUT – G General Contract**

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Architect promptly.
- B. Engage a land surveyor experienced in laying out the Work, using the following accepted surveying practices:

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
  2. Establish limits on use of Project site.
  3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
  4. Inform installers of lines and levels to which they must comply.
  5. Check the location, level and plumb, of every major element as the Work progresses.
  6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
  7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

### 3.4 FIELD ENGINEERING – **G General Contract**

- A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
  2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- B. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
  2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
  3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

### 3.5 INSTALLATION – All Contracts

- A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
  - 1. Make vertical work plumb, and make horizontal work level.
  - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
  - 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
  - 4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces, unless otherwise indicated on Drawings.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.
- F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.
  - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
  - 2. Allow for building movement, including thermal expansion and contraction.
  - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

- I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.
- J. Repair or remove and replace damaged, defective, or nonconforming Work.
  - 1. Comply with Section 017700 "Closeout Procedures" for repairing or removing and replacing defective Work.

### **3.6 CUTTING AND PATCHING – All Contracts**

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
  - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Temporary Support: Provide temporary support of Work to be cut.
- C. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- D. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
  - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
  - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
  - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
  - 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
- E. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.
  - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
  - 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

- a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
  - b. Restore damaged pipe covering to its original condition.
- 3. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- F. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

### **3.7 PROGRESS CLEANING – All Contracts**

- A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
  - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
  - 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
  - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
    - a. Use containers intended for holding waste materials of type to be stored.
  - 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.
  - 1. Remove liquid spills promptly.
  - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."

- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 **STARTING AND ADJUSTING – All Contracts**

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.9 **PROTECTION AND REPAIR OF INSTALLED CONSTRUCTION – All Contracts**

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.
- C. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

## SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
  - 1. Disposing of nonhazardous demolition and construction waste.
- B. Related Requirements:
  - 1. Section 011200 "Multiple Contract Summary" for coordination of responsibilities for waste management.
  - 2. Section 024116 "Structure Demolition" for disposal of demolition waste
  - 3. Section 042000 "Unit Masonry" for disposal requirements for masonry waste.
  - 4. Section 311000 "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

#### 1.2 DEFINITIONS

- A. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building, structure, and site improvement materials resulting from demolition operations.
- C. Disposal: Removal of demolition or construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction, or designated spoil areas on Owner's property.

#### 1.3 ACTION SUBMITTALS

- A. Waste Management Plan: Submit plan within 7 days of date established for commencement of the Work.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
- B. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

- C. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- D. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION – **ALL PRIME CONTRACTS**

3.1 IMPLEMENTATION

- A. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
- B. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
  - 1. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 RECYCLING CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
  - 1. Remove recyclable waste from Owner's property and transport to recycling receiver or processor as often as required to prevent overfilling bins.

3.3 RECYCLING CONSTRUCTION WASTE

- A. Packaging:
  - 1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
  - 2. Polystyrene Packaging: Separate and bag materials.
  - 3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.



4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.
- B. Wood Materials:
  1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
  2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
- C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.
  1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.
- D. Paint: Seal containers and store by type.

### 3.4 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged or recycled, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
  1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
  2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. General: Except for items or materials to be salvaged or recycled, remove waste materials and legally dispose of at designated spoil areas on Owner's property.
- C. Burning: Do not burn waste materials.

END OF SECTION 017419

## SECTION 017700 - CLOSEOUT PROCEDURES

### PART 1 - GENERAL -**ALL CONTRACTS**

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:
  - 1. Substantial Completion procedures.
  - 2. Final completion procedures.
  - 3. Warranties.
  - 4. Final cleaning.
- B. Related Requirements:
  - 1. Section 006000 "General Conditions of the Contract for Construction" for additional requirements.
  - 2. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
  - 3. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
  - 4. Section 017900 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of cleaning agent.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at Final Completion.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.
- C. Field Report: For pest-control inspection.

#### 1.4 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
  - 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
  - 2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
  - 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
  - 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number.
  - 5. Submit testing, adjusting, and balancing records.
  - 6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
  - 1. Advise Owner of pending insurance changeover requirements.
  - 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
  - 3. Complete startup and testing of systems and equipment.
  - 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
  - 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
  - 6. Advise Owner of changeover in utility services.
  - 7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
  - 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
  - 9. Complete final cleaning requirements.
  - 10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and

tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

## 1.5 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:
1. Submit a final Application for Payment in accordance with Section 012900 "Payment Procedures."
  2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
  3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
  4. Submit pest-control final inspection report.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

## 1.6 LIST OF INCOMPLETE ITEMS

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
1. Organize list of spaces in sequential order, listed by room or space number.
  2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
  3. Include the following information at the top of each page:
    - a. Project name.
    - b. Date.
    - c. Name of Contractor.
    - d. Page number.
  4. Submit list of incomplete items in the following format:
    - a. MS Excel Electronic File: Architect will return annotated file.

## 1.7 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
- C. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
  - 1. Submit by email to Architect.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

## PART 3 - EXECUTION

### 3.1 FINAL CLEANING – **All Prime Contracts for their own Work**

- A. Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
  - 1. Complete the following cleaning operations before requesting inspection for certification of Final Completion for entire Project or for a designated portion of Project:
    - a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
    - b. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
    - c. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.

- d. Clean flooring, removing debris, dirt, and staining; clean according to manufacturer's recommendations.
  - e. Vacuum and mop concrete.
  - f. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
  - g. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
  - h. Remove labels that are not permanent.
  - i. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
  - j. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
  - k. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
  - l. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
  - m. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
  - n. Clean strainers.
  - o. Leave Project clean and ready for occupancy.
- C. Construction Waste Disposal: Comply with waste-disposal requirements in Section 017419 "Construction Waste Management and Disposal."

### 3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations required by Section 017300 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION 017700

## SECTION 017823 - OPERATION AND MAINTENANCE DATA

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
  - 1. Operation and maintenance documentation directory manuals.
  - 2. Emergency manuals.
  - 3. Systems and equipment operation manuals.
  - 4. Systems and equipment maintenance manuals.
  - 5. Product maintenance manuals.

#### 1.2 CLOSEOUT SUBMITTALS

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
  - 1. Architect will comment on whether content of operation and maintenance submittals is acceptable.
  - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:
  - 1. Submit on digital media acceptable to Architect. Enable reviewer comments on draft submittals.
  - 2. Submit one final paper copies. Architect will forward the copy to the Owner copies.
- C. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 10 days before commencing demonstration and training. Architect will return copy with comments.
  - 1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 10 days of receipt of Architect's comments and prior to commencing demonstration and training.
- D. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

### 1.3 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
  - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
  - 2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- B. Manuals, Final Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.
  - 1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
  - 2. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
    - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
    - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

### 1.4 REQUIREMENTS FOR OPERATION, AND MAINTENANCE MANUALS

- A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
  - 1. Title page.
  - 2. Table of contents.
  - 3. Manual contents.
- B. Title Page: Include the following information:
  - 1. Subject matter included in manual.
  - 2. Name and address of Project.
  - 3. Name and address of Owner.
  - 4. Date of submittal.
  - 5. Name and contact information for Contractor.



6. Name and contact information for Architect.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

#### 1.5 SYSTEMS AND EQUIPMENT OPERATION MANUALS

- A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.
- B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
  1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
  2. Performance and design criteria if Contractor has delegated design responsibility.
  3. Operating standards.
  4. Operating procedures.
  5. Operating logs.
  6. Wiring diagrams.
  7. Control diagrams.
  8. Piped system diagrams.
  9. Precautions against improper use.
  10. License requirements including inspection and renewal dates.
- C. Descriptions: Include the following:
  1. Product name and model number. Use designations for products indicated on Contract Documents.
  2. Manufacturer's name.
  3. Equipment identification with serial number of each component.
  4. Equipment function.
  5. Operating characteristics.
  6. Limiting conditions.
  7. Performance curves.

8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

D. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

F. Piped Systems: Diagram piping as installed and identify color coding where required for identification.

## 1.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.

B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds, as described below.

C. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
  2. Troubleshooting guide.
  3. Precautions against improper maintenance.
  4. Repair, and replacement; and reassembly instructions.
  5. Aligning, adjusting, and checking instructions.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

#### 1.7 PRODUCT MAINTENANCE MANUALS

- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- C. Product Information: Include the following, as applicable:
1. Product name and model number.
  2. Manufacturer's name.
  3. Color, pattern, and texture.
  4. Material and chemical composition.
  5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
1. Inspection procedures.
  2. Types of cleaning agents to be used and methods of cleaning.
  3. List of cleaning agents and methods of cleaning detrimental to product.
  4. Schedule for routine cleaning and maintenance.
  5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017823

## SECTION 017839 - PROJECT RECORD DOCUMENTS

### PART 1 - GENERAL – **All Contracts**

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for Project Record Documents, including the following:
  - 1. Record Drawings.
  - 2. Record Product Data.
- B. Related Requirements:
  - 1. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

#### 1.2 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
  - 1. Number of Copies: Submit copies of Record Drawings as follows:
    - a. Initial Submittal:
      - 1) Submit PDF electronic files of scanned record prints and one set(s) of file prints.
    - b. Final Submittal:
      - 1) Submit PDF electronic files of scanned Record Prints and one set(s) of file prints. Architect will forward prints to the Owner.
- B. Record Product Data: Submit annotated PDF electronic files and directories and one paper copies of each submittal.

#### 1.3 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
  - 1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

- a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    - b. Accurately record information in an acceptable drawing technique.
    - c. Record data as soon as possible after obtaining it.
    - d. Record and check the markup before enclosing concealed installations.
    - e. Cross-reference record prints to corresponding photographic documentation.
  2. Content: Types of items requiring marking include, but are not limited to, the following:
    - a. Dimensional changes to Drawings.
    - b. Revisions to details shown on Drawings.
    - c. Depths of foundations.
    - d. Locations and depths of underground utilities.
    - e. Revisions to routing of piping and conduits.
    - f. Revisions to electrical circuitry.
    - g. Actual equipment locations.
    - h. Duct size and routing.
    - i. Locations of concealed internal utilities.
    - j. Changes made by Change Order or Construction Change Directive.
    - k. Changes made following Architect's written orders.
    - l. Details not on the original Contract Drawings.
    - m. Field records for variable and concealed conditions.
    - n. Record information on the Work that is shown only schematically.
  3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
  4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
  5. Mark important additional information that was either shown schematically or omitted from original Drawings.
  6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, scan a full set of corrected drawings of the Contract Drawings, as follows:
1. Format: Annotated PDF electronic file.
  2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
  3. Refer instances of uncertainty to Architect for resolution.
- C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
  2. Format: Annotated PDF electronic file.
  3. Identification: As follows:

- a. Project name.
- b. Date.
- c. Designation "PROJECT RECORD DRAWINGS."
- d. Name of Architect.
- e. Name of Contractor.

#### 1.4 RECORD PRODUCT DATA

- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.
- B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
  1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
  3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.
- C. Format: Submit Record Product Data as scanned PDF electronic file(s) of marked-up paper copy of Product Data.
  1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

#### 1.5 MAINTENANCE OF RECORD DOCUMENTS

- A. Maintenance of Record Documents: Store Record Documents apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference as requested.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017839





## SECTION 017900 - DEMONSTRATION AND TRAINING

### PART 1 - GENERAL – **ALL CONTRACTS**

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
  - 1. Instruction in operation and maintenance of systems, subsystems, and equipment.

#### 1.2 QUALITY ASSURANCE

- A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.

#### 1.3 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate content of training modules with content of approved operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

#### 1.4 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Systems Training: Develop a teaching outline for each system. For each system, include instruction for the following as applicable to the system, equipment, or component:
  - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
    - a. System, subsystem, and equipment descriptions.
    - b. Performance and design criteria if Contractor is delegated design responsibility.
    - c. Operating standards.
    - d. Regulatory requirements.
    - e. Equipment function.
    - f. Operating characteristics.

- g. Limiting conditions.
  - h. Performance curves.
- 2. Documentation: Review the following items in detail:
  - a. Emergency operations.
  - b. Systems and equipment operation manuals.
  - c. Systems and equipment maintenance manuals.
  - d. Product maintenance manuals.
  - e. Project Record Documents.
  - f. Identification systems.
  - g. Warranties and bonds.
  - h. Maintenance service agreements and similar continuing commitments.
- 3. Emergencies: Include the following, as applicable:
  - a. Instructions on meaning of warnings, trouble indications, and error messages.
  - b. Instructions on stopping.
  - c. Shutdown instructions for each type of emergency.
  - d. Operating instructions for conditions outside of normal operating limits.
  - e. Sequences for electric or electronic systems.
  - f. Special operating instructions and procedures.
- 4. Operations: Include the following, as applicable:
  - a. Startup procedures.
  - b. Equipment or system break-in procedures.
  - c. Routine and normal operating instructions.
  - d. Regulation and control procedures.
  - e. Control sequences.
  - f. Safety procedures.
  - g. Instructions on stopping.
  - h. Normal shutdown instructions.
  - i. Operating procedures for emergencies.
  - j. Operating procedures for system, subsystem, or equipment failure.
  - k. Seasonal and weekend operating instructions.
  - l. Required sequences for electric or electronic systems.
  - m. Special operating instructions and procedures.
- 5. Adjustments: Include the following:
  - a. Alignments.
  - b. Checking adjustments.
  - c. Noise and vibration adjustments.
  - d. Economy and efficiency adjustments.
- 6. Troubleshooting: Include the following:
  - a. Diagnostic instructions.

- b. Test and inspection procedures.
- 7. Maintenance: Include the following:
  - a. Inspection procedures.
  - b. Types of cleaning agents to be used and methods of cleaning.
  - c. List of cleaning agents and methods of cleaning detrimental to product.
  - d. Procedures for routine cleaning.
  - e. Procedures for preventive maintenance.
  - f. Procedures for routine maintenance.
- 8. Repairs: Include the following:
  - a. Diagnosis instructions.
  - b. Repair instructions.
  - c. Repair, and replacement; and reassembly instructions.
  - d. Instructions for identifying parts and components.
  - e. Review of spare parts needed for operation and maintenance.

#### 1.5 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

#### 1.6 INSTRUCTION

- A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
- B. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
  - 1. Schedule training with Owner with at least seven days' advance notice.
- C. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- D. Cleanup: Restore systems and equipment to condition existing before initial training use.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017900

**SECTION 02 41 13**  
**SITE DEMOLITION AND REMOVALS**

**PART 1 - GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Division 1 General Requirements and Specific Requirements, apply to this Section. All work to be coordinated with environmental requirements for the project.

**1.02 SUMMARY**

- A. The work of this Section includes the following:
  - 1. Site demolition and removals as indicated on the Drawings.

**1.03 RELATED SECTIONS**

- A. Section 31 25 00 – Erosion and Sediment Controls

**1.04 PROJECT CONDITIONS**

- A. Traffic: Conduct site clearing operations to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct streets, walks, or other occupied or used facilities without permission from authorities having jurisdiction.
- B. Protection of Existing Improvements: Provide protections necessary to prevent damage to existing improvements indicated to remain in place.
  - 1. Protect site improvements on adjoining properties and on NY State property to remain.
  - 2. Restore damaged improvements to their original condition, as acceptable to property owners.
- C. Review and verify all limits of items to be removed with NY State and Site Architect prior to commencing clearing and grubbing operations.
- D. Inspection: Verify existing condition of all plant material scheduled for clearing and grubbing removal. Do not proceed with any work that will result with unsafe conditions causing a continuing or permanent hazard. Ascertain that all work and scheduled for clearing and grubbing can be safely accomplished in a proper time period.
- E. Benchmarks: Protect all survey monuments, benchmarks, and property boundary pins. Replace if destroyed by Contractor's operations at no cost to NY State. Contractor to provide temporary offsets to benchmarks during clearing & grubbing and construction and provide new monuments as part of this construction.
- F. Permits/Fees: Coordinate with appropriate utility companies and pay any connection and/or disconnect fees and permits as necessary.
- G. Stockpiled Improvements: Carefully remove items indicated to be stockpiled and store on NY State's premises where indicated or directed.
- H. Provide 48 hours notice prior to conducting any site clearing and grubbing operation.

- I. Contact Dig Safely, New York at 811 or (1 800 962 7962) prior to commencing any demolition operations.

#### 1.05 EXISTING SERVICES

- A. General: Indicated locations are approximate. Contractor is responsible for determining exact extent and locations before commencing Work.

### **PART 2 - PRODUCTS – NOT USED**

### **PART 3 - EXECUTION**

#### 1.06 DEMOLITION

- A. Demolish site features shown on the plans.
- B. Clear and grub areas as indicated on the plans.
- C. Remove trees and stumps in areas indicated on the plans.
- D. Take care not to damage any features that are to remain. Repair existing features to remain that are damaged by demolition operations.
- E. All demolished features will become the property of the contractor except as noted.

#### 1.07 DISPOSAL

- A. All waste material shall be disposed of legally off site.
- B. Suitable excess earth materials, as determined by the Site Architect, will remain on site in a location directed by NY State and/or the Site Architect.
- C. No burning or burying on-site will be allowed.

**END OF SECTION 02 41 13**

## SECTION 024116 - STRUCTURE DEMOLITION

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. The Work of this Section Includes:

1. Demolition and removal of buildings or structures.
2. Demolition and removal of site improvements.
3. Removing below-grade construction.
4. Disconnecting, capping or sealing, and removing site utilities.

B. Related Requirements:

1. Section 011000 "Summary" for use of the premises and phasing requirements.

#### 1.2 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

#### 1.3 COORDINATION

A. Arrange demolition schedule so as not to interfere with Owner's on-site operations or operations of adjacent occupied buildings.

#### 1.4 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1.5 INFORMATIONAL SUBMITTALS

- A. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.
  - 1. Adjacent Buildings: Detail special measures proposed to protect adjacent buildings to remain including means of egress from, and access to those buildings.
- B. Schedule of building demolition activities with starting and ending dates for each activity.
- C. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician.

1.6 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Universal certified by an EPA-approved certification program.

1.7 FIELD CONDITIONS

- A. Building to be demolished will be vacated and its use discontinued before start of the Work.
- B. Buildings immediately adjacent to demolition area will be occupied. Conduct building demolition so operations of occupied buildings will not be disrupted.
  - 1. Provide not less than 72 hours' notice of activities that will affect operations of adjacent occupied buildings.
  - 2. Maintain access to existing walkways, exits, and other facilities used by occupants of adjacent buildings.
    - a. Do not close or obstruct walkways, exits, or other facilities used by occupants of adjacent buildings without written permission from authorities having jurisdiction.
- C. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- D. Hazardous Materials:
  - 1. Hazardous materials are present in buildings and structures to be demolished. A report on the presence of hazardous materials is included in Section 003126 "Existing Hazardous



Material Information" for review and use. Examine report to become aware of locations where hazardous materials are present.

2. Appropriately remediate identified hazardous material per the regulations of New York State and the local jurisdiction, prior to demolition.

- E. On-site sale of removed items or materials is not permitted.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.

### 2.2 SOIL MATERIALS

- A. Satisfactory Soils: Comply with requirements in Section 310000 "Earthwork."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting demolition operations.
- B. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video. Comply with Section 013233 "Photographic Documentation."
  1. Photograph or video existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by demolition operations.

### 3.2 PREPARATION

- A. Existing Facilities: Protect adjacent walkways, building entries, and other building facilities during demolition operations. Maintain exits from existing buildings.
- B. Temporary Protection: Erect temporary protection, such as fences and barricades, where required by authorities having jurisdiction and as indicated. Comply with requirements in Section 015000 "Temporary Facilities and Controls."
  - 1. Protect adjacent buildings and facilities from damage due to demolition activities.
  - 2. Protect existing site improvements, appurtenances, and landscaping to remain.
  - 3. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
  - 4. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
  - 5. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.
- C. Existing Utilities to Remain: Maintain utility services to remain and protect against damage during demolition operations.
  - 1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.
  - 2. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and authorities having jurisdiction.
    - a. Provide at least 72 hours' notice to occupants of affected buildings if shutdown of service is required during changeover.
- D. Existing Utilities to Be Disconnected: Locate, identify, disconnect, and seal or cap off utilities serving buildings and structures to be demolished.
  - 1. Owner will arrange to shut off utilities when requested by Contractor.
  - 2. Arrange to shut off utilities with utility companies.
  - 3. If disconnection of utility services will affect adjacent occupied buildings, then provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.
  - 4. Cut off pipe or conduit a minimum of 24 inches below grade at or outside the building or structure to be demolished and cap, valve, or plug and seal remaining portion of pipe or

- conduit after bypassing in accordance with requirements of authorities having jurisdiction.
5. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing by authorities having jurisdiction.

- E. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment in accordance with 40 CFR 82 and regulations of authorities having jurisdiction.

### 3.3 DEMOLITION, GENERAL

- A. General: Demolish indicated buildings and site improvements completely. Use methods required to complete the Work within limitations of governing regulations and as follows:
  1. Do not use cutting torches until work area is cleared of flammable materials. Maintain portable fire-suppression devices during flame-cutting operations.
  2. Maintain fire watch during and for at least 4 hours after flame-cutting operations.
  3. Maintain adequate ventilation when using cutting torches.
  4. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
- B. Site Access and Temporary Controls: Conduct building demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
  1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed trafficways if required by authorities having jurisdiction.
  2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions.
- C. Explosives: Use of explosives is not permitted.

### 3.4 DEMOLITION BY MECHANICAL MEANS

- A. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete building demolition operations above each floor or tier before disturbing supporting members on the next lower level.
- B. Remove debris from elevated portions of the building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- C. Below-Grade Construction:

1. Demolish foundation systems and other below-grade construction that are within footprint of new construction and extending 5 ft. outside footprint indicated for new construction. Abandon below-grade construction outside this area.
  - a. Remove below-grade construction, including basements, foundation systems, and footings, to at least 24 inches below grade, or completely if located in conflict with proposed new work.

D. Existing Utilities:

1. Abandon existing utilities and below-grade utility structures. Cut utilities flush with grade.
2. Demolish existing utilities and below-grade utility structures that are within 5 ft. outside footprint indicated for new construction. Abandon utilities outside this area.

3.5 SITE RESTORATION

A. Below-Grade Areas:

1. Rough grade below-grade areas ready for further excavation or new construction.
2. Completely fill below-grade areas and voids resulting from building demolition operations with satisfactory soil materials in accordance with backfill requirements in Section 310000 "Earthwork."

3.6 REPAIRS

- A. Promptly repair damage to adjacent buildings caused by demolition operations.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.
1. Do not allow demolished materials to accumulate on-site.
  2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Do not burn demolished materials.

3.8 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by building demolition operations. Return adjacent areas to condition existing before building demolition operations began.

END OF SECTION 024116

**SECTION 33 30 00**

**SANITARY SEWER**

**PART 1 - GENERAL**

**1.01 RELATED DOCUMENTS**

- A. The General Provisions of the Contract, including General and Supplementary Conditions, and Division One General Requirements apply to the work specified in this section.
- B. "Standard Specifications" shall mean the State of New York Department of Transportation Standard Specifications, May 1, 2024, its latest edition and any supplemental specifications.

**1.02 DESCRIPTION OF WORK**

- A. Work Included: Furnish and install gravity sewer pipe from a point five (5) feet outside of any building construction to the point of tie-in at the sanitary sewer as indicated on the Drawings. This section also includes the following:
  - 1. Trenching, including dewatering and shoring.
  - 2. Backfill and compaction.
  - 3. Connecting to new sanitary manhole location as shown on the Drawings.

**1.03 RELATED WORK**

- A. Section 31 25 00 – Erosion and Sediment Control
- B. Section 31 23 16 – Earthwork
- C. Section 31 23 33 – Trenching

**1.04 QUALITY ASSURANCE**

- A. Environmental Compliance: Comply with applicable portions of local environmental agency regulations pertaining to sanitary sewerage systems.
- B. Utility Compliance: Compliance with local utility regulations and standards pertaining to sanitary sewerage systems.

1.05 SUBMITTALS

- A. Product data for drainage pipes and specialty products.
- B. Records drawings at project closeout of installed sanitary sewer in accordance with the requirements of Division 1.

**PART 2 - PRODUCTS**

2.01 PVC (POLYVINYL CHLORIDE) SEWER PIPE AND FITTINGS

- A. Force Main Pipe: PVC Sewer Pipe and Fittings conforming to the following:
  - 1. PVC Pressure Pipe: AWWA C900, Class 150, for gasketed joints.
  - 2. PVC Pressure Fittings: AWWA C907, for gasketed joints.
  - 3. Gaskets for PVC Piping: ASTM F 477, elastomeric seals.
  - 4. Ductile-Iron, Compact Fittings: AWWA C153, for push-on joints.
  - 5. Gaskets for Ductile-Iron Fittings: AWWA C111, rubber.
- B. Gravity Pipe: PVC Sewer Pipe and Fittings conforming to the following:
  - 1. PVC Sewer Pipe and Fittings, NPS 15 (DN375) and Smaller: ASTM D 3034, SDR 35, for solvent-cemented or gasketed joints.
  - 2. Gaskets: ASTM F 477, elastomeric seals.

2.02 DUCTILE IRON PIPE AND FITTINGS

- A. AWWA C151, Class 56. Fittings shall be ductile iron or cast iron, AWWA C110, 250 PSI, mechanical joint.
- B. Lining: AWWA C104, cement mortar, seal coated.
- C. Gaskets: AWWA C111, rubber.
- D. Encasement: AWWA C105, polyethylene film tube.

## 2.03 IDENTIFICATION

- A. Plastic Underground Warning Tapes: Polyethylene plastic tape, 6 inches wide by 4 mils thick, solid green in color with continuously printed caption in black letters "CAUTION - SEWER LINE BURIED BELOW".

## PART 3 - EXECUTION

### 3.01 GENERAL

- A. Prior to installation, ensure excavations and trench bottoms have been prepared in accordance with Section 31 23 33.

### 3.02 INSTALLATION

- A. Coordinate sanitary sewer installation with other project work.
- B. Trenching, including dewatering and shoring, shall conform to the requirements of Section 31 23 33.
- C. Backfill and compaction shall conform to the requirements of Section 31 23 16.
- D. Install gravity piping beginning at low point of system, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets and seals in accordance with manufacturer's recommendations. Maintain swab or drag in line and pull past each joint as it is completed.
- E. Use proper size increasers, reducers and couplings where different sizes or materials of pipes and fittings are connected. Reduction of the size or piping in the direction of flow is prohibited.
- F. Install piping to grade and elevations as shown on plans.
- G. Join and install PVC pipe in accordance with ASTM D 3212.

### 3.03 PLUG EXISTING PIPE

- A. Contractor shall plug existing sanitary pipe that are to be abandoned at the location as shown on the Drawings. The cement masonry must be securely adhered to the pipe to prevent the plug from moving down the pipe. The plug shall be watertight.

### 3.04 INSTALLATION OF IDENTIFICATION

- A. Install continuous plastic underground warning tape during backfilling of trench for underground water service piping. Locate 6 to 8 inches below finished grade, directly over piping.



3.05 FIELD QUALITY CONTROL

- A. Cleaning: Clear interior of piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed.
  - 1. In large, accessible piping, brushes and brooms may be used for cleaning.
  - 2. Place plugs in ends of uncompleted pipe at end of day or whenever work stops.
- B. Interior Inspection: Inspect piping to determine whether line displacement or other damage has occurred.
  - 1. Make inspections after pipe between designated locations has been installed and approximately two (2) feet of backfill is in place, and again at completion of project.
  - 2. If inspection indicates poor alignment, debris, displaced pipe, infiltration, or other defects, correct such defects and re-inspect.
- C. Testing: Pressure test all manholes and force main in accordance with Town of Stonington Water Pollution Control Authority requirements.

**END OF SECTION 33 30 00**

## **SECTION 02 74 10**

### **BITUMINOUS CONCRETE PAVEMENT AND MARKINGS**

#### **PART 1 - GENERAL**

##### **1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions and Special Conditions, apply to this Section.
- B. "Standard Specifications" shall mean the State of New York Department of Transportation Standard Specifications, May 1, 2024, its latest edition and any supplemental specifications.

##### **1.02 SECTION INCLUDES**

- A. This Section includes the materials, labor, installation and incidental costs for the installation of subbase material, base materials, bituminous concrete pavement and markings.

##### **1.03 SUBMITTALS**

- A. Material Certificates: Provide material certificates signed by the material producer and the Contractor, certifying that materials and products comply with specified requirements.

##### **1.04 QUALITY ASSURANCE**

- A. Material and Methods of Construction: Shall comply with the following standards:
  - 1. American Society for Testing and Materials (ASTM).
  - 2. American Association of State Highway and Transportation Officials (AASHTO).
  - 3. Asphalt Institute (AI).
  - 4. State of New York Department of Transportation Standard Specifications, inclusive of all supplements.
- B. Testing: Compaction tests will be required by the Engineer and shall be paid for by the Contractor. If tests indicate that density requirements have not been achieved, the Contractor shall continue compacting. All retesting in these areas shall be paid for by the Contractor.
- C. Density and Compaction Testing: The Contractor is responsible to schedule compaction tests if required by the Owner and to allow adequate time for the proper execution of said tests.

- D. Allowable Tolerances: Final surface of base materials within 3/8" from a required grade. Final pavement thicknesses shall conform to specified requirements as shown in the Drawings. Test for smoothness using a ten (10) foot long straightedge. Surface shall not vary more than 1/4" from straightedge when placed in any direction. In no case will water be allowed to stand or puddle on any finished pavement.
- E. Permits/Approvals: The Contractor shall obtain approval of construction and secure all permits for all work.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Transporting shipments of bituminous concrete material shall be made in tight vehicles previously cleaned of all foreign material, and delivered to the site, so that it will not become contaminated in any way.

1.06 PROJECT CONDITIONS

- A. Weather Limitations
  - 1. Base material shall not be placed on frozen or saturated subbase material.
  - 2. Bituminous concrete paving material shall not be placed on frozen or saturated base material.
  - 3. Cold weather: Bituminous concrete paving materials shall be mixed and placed in accordance with minimum placement temperature as specified in Section 405-3.01 Weather Limitations, Standard Specifications.
  - 4. Precipitation or Moisture: Placement of bituminous concrete paving materials shall not be scheduled when weather conditions of fog or rain prevail nor when the pavement surface shows signs of any moisture.
  - 5. Precipitation Probability: Placement of bituminous concrete paving materials shall not be scheduled when the Precipitation Probability, obtained by the Contractor from the U.S. Weather Bureau Within three (3) hours prior to the start of such operations, equals or exceeds fifty (50) percent. The Contractor shall notify the Engineer of the exact time at which the above information was obtained.
- B. Grade Control: Establish and maintain the required lines and grades for each course during paving operations.
- C. Provide temporary barricades and warning lights as required for protection of project work and public safety.
- D. Protect adjacent work from damage, soiling and staining during paving operations.
- E. Inspection Costs: All costs associated with material certifications, plant inspection and laboratory tests shall be borne by the Contractor and shall be deemed included in the price bid for asphalt pavement.

## **PART 2 - PRODUCTS**

### **2.01 BITUMINOUS CONCRETE PAVEMENT**

- A. Conform to the requirements of Standard Specifications, Section 403-2 .

### **2.02 TACK COAT**

- A. Conform to the requirements of Standard Specifications, Section 702-10.

### **2.03 SUBBASE**

- A. Conform to the requirements of Section 304-2.02 of the Standard Specifications.

### **2.04 PAINT**

- A. Pavement Markings - Paint shall be hot-applied, fast drying type in accordance with "Standard Specifications".

## **PART 3 - EXECUTION**

### **3.01 INSPECTION**

- A. Verify that all existing utility openings, valves, and other project installations are at their proper finished grade elevations, within areas to be paved.
- B. Provide temporary closures and protection over openings until completion of rolling operations.
- C. Remove closures at completion of the work. Set covers to grade, flush with the surface of the adjoining pavement.

### **3.02 SUBGRADE PREPARATION**

- A. Prior to placing the bottom course of processed stone aggregate base, the prepared subgrade shall be maintained true to line and grade, at all times for a minimum distance of 200 feet in advance of the work. No placement of the processed aggregate is to commence until acceptance of the subgrade on which it is to be placed.
- B. The formation and protection of subgrade shall conform to the requirements of Section 2.09.01 and 2.09.03, Standard Specifications.

### **3.03 BASE COURSE MATERIAL PLACEMENT/COMPACTION**

- A. Install processed aggregate base material at the locations as shown on the Drawings and in accordance with Section 203 of the Standard Specifications. Dimensions specified are after compaction.

- B. Compact base material with vibratory roller to minimum 95% modified AASHTO laboratory density (ASTM D-1557, Method C).
- C. Insure thorough and proper compaction around all yard drains, catch basins, structures, utility valves, and other improvements that project above base material.

### 3.04 BITUMINOUS CONCRETE PAVEMENT

#### A. General

1. Install the bituminous concrete pavement to the lines, grades, and details shown on the Drawings and in accordance with Section 403 of the Standard Specifications. Neatly and cleanly meet and match abutting pavements. Remove all soft or yielding material below grade and replace with suitable material.
2. Thicknesses after compaction shall conform to the details on the Drawings. The pavement shall consist of the number of courses and thickness as detailed. Remove and replace areas showing deficiencies in required thickness with new material as directed.
3. Protect existing abutting pavement during paving operations. Replace any abutting pavement damaged during paving operations. Joint between bituminous pavement and existing Portland cement concrete pavement shall be tightly compacted and pavement edge shall be of equal density to other areas of pavement.
4. Provide a cross-pitch of 1/4" per foot for proper drainage. Ensure that there are no low spots that may trap water and create a slipping hazard.

#### B. Placing

1. Bituminous concrete pavement shall be constructed and compacted in conformance with Section 403 of the Standard Specifications.
2. Coat the edge of all abutting pavement with tack coat before installing bituminous concrete pavements. Insure that the abutting pavement has a sound, clean, straight edge. Feathering of edges and transitions between new and existing pavements is not acceptable. Protect surfaces of abutting pavement from tack coat overspray.
3. Each mixture shall be furnished and laid by means of a mechanical spreader of approved design to a depth which after final compaction shall be equal to the specified depth. In areas where the use of a mechanical spreader is impractical, as determined by the Engineer, other means of spreading and compacting may be permitted.
4. After placing and compacting binder course, tack coat shall be applied prior to placement of the wearing (top) course.
5. Each mixture shall be laid only where the surface to be covered is free from loose or foreign material, dry, and only when weather conditions are suitable.

6. Provide suitable means for keeping all small tools clean and free from bituminous accumulations.
7. Pavement may be laid by hand. Pavement shall be compacted by making multiple passes with a roller weighing not less than 2,000 pounds. After compaction, the thickness shall be that as specified on the drawings.

C. Compacting

1. Upon completion of the spreading of each mixture, the material shall be consolidated thoroughly and uniformly with self-propelled tandem rollers. The top course shall be free from roller marks.
2. Rollers used for compacting the top course shall be well balanced, self-propelled, tandem rollers, weighing between seven (7) and eight (8) tons. The roller shall have a compression under the rear wheel of between 200 and 300 pounds per linear inch of roll at a rate not exceeding 800 square yards per hour per roller. After compaction, the surface course shall have a density not less than 97% theoretical maximum density as determined by Appendix B of The Asphalt Institute Manual MS-2.
3. Locations inaccessible to the roller, the compression shall be effected with iron tampers weighing not less than twenty-five (25) pounds and having a bearing area not exceeding forty-eight (48) square inches, or other impact type equipment.
4. Perform breakdown, second and finish rolling until the bituminous concrete mixture has been compacted to the required surface density and smoothness. Continue rolling until all roller marks are eliminated. Provide a smooth compacted surface true to thickness and elevations required.
5. After final rolling, do not permit vehicular traffic on the pavement until it has cooled and hardened, and in no case sooner than 8 hours.

D. Joints for New Construction and Between Existing Pavement:

1. Carefully make joints between old and new pavements, and between successive days' work, to ensure a continuous bond between adjoining work. Construct joints to have the same texture, density, and smoothness as other sections of the asphalt concrete course.
2. Construction shall be as nearly continuous as is possible. The roller shall pass over the end of the laid mixture only when a practical necessity.
3. When the operation of laying is interrupted, the end of the laid material shall be left unrolled until such time as work is resumed, in order that there be no joints throughout the project.
4. If it is necessary to roll the end of the laid mixture during construction, thus consolidating it, the joint so made shall be cut back before resuming the

operation of laying, in order to present a fresh, clean surface for contact with the newly placed material.

5. The edges of such joints shall be painted with liquid asphalt (RC-70 or MC-70) and the use of hot smoothing irons in finishing such joints, shall not be permitted.

E. Finished Surface

1. The surface of the top course of the pavement after compression shall be smooth and true to crown and grade, free from depressions, waves, bunches, overlapping seams and unevenness in surface. All new surfaces shall meet existing surfaces smoothly and evenly.
2. After the compaction of the top course, the Contractor shall check the entire paved area for depressions, using a ten (10) foot wood or metal straightedge. Any depressions greater than three-sixteenths (3/16) of an inch shall be corrected by removing the top course of the affected areas, and replacing with new material to form a true and even surface.

- F. Defects: Where defects in composition, compression or finish appear in the completed work, such finished areas shall be removed to the full depth of the course and the defective material replaced with the required thickness of pavement at the expense of the contractor.

1. Patching: Remove and replace mixtures that become mixed with foreign materials and all defective areas. Cut out such areas and fill with fresh hot asphalt concrete. Compact by rolling to the required surface density and smoothness. Remove deficient areas for the full depth of the course. Cut sides perpendicular and parallel to the directions of traffic with edges vertical. Apply a tack coat before placing asphalt concrete mixture.

3.05 PAINTED PAVEMENT MARKINGS

A. Pavement Markings

1. Existing painted pavement markings shall be removed by sandblasting or milling. Painting over existing markings will not be allowed.
2. Pavement areas to be painted shall be dry and sufficiently cleaned of sand, dust and road debris so as to provide an acceptable bond between the paint and the pavement.
3. Fast drying paint shall be applied at a temperature of 120 F to 150 F at the spray gun.
4. All paint shall be performed in a neat and workmanlike manner, using approved mechanical equipment. Lines shall be sharp and clear with no feathered edging or fogging and precautions shall be taken to prevent tracking by tires of the striping equipment. Paint shall be applied as shown on the plans with no unsightly deviations.

5. After application, the paint shall be protected from crossing vehicles for a time at least equivalent to the drying time of the paint.

3.06 PROTECTION/CLEAN-UP

- A. Protect all work until acceptance of the project. Replace or repair pavement if damaged prior to acceptance.
- B. Clean up all debris from installation procedures, including but not limited to bituminous concrete and base material overflow into/onto areas indicated to be lawn or other surfaces. Remove from site all excess materials, debris and equipment. Contractor shall dispose of debris material legally.
- C. Repair damage resulting from paving operation to other areas of the work.

**END OF SECTION 02 74 10**



## SECTION 033000 - CAST-IN-PLACE CONCRETE

### 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 cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
  - 1. Footings.
  - 2. Foundation walls.
  - 3. Slabs-on-grade.
  - 4. Concrete Toppings.
- B. Related Sections:
  - 1. Division 31 Section "Earth Moving" for drainage fill under slabs-on-grade.
  - 2. Division 32 Section "Concrete Paving" for concrete pavement and walks.

#### 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.
- B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. Portland cement.
  - 2. Fly ash.
  - 3. Slag cement.
  - 4. Blended hydraulic cement.
  - 5. Aggregates.

6.     Admixtures:
    - a.     Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.
  7.     Vapor retarders.
  8.     Liquid floor treatments.
  9.     Curing materials.
  10.    Joint fillers.
  11.    Water stops
- B.     Design Mixtures: For each concrete mixture, include the following. 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.
  2.     Mixture identification.
  3.     Minimum 28-day compressive strength.
  4.     Durability exposure class.
  5.     Maximum w/cm.
  6.     Calculated equilibrium unit weight, for lightweight concrete.
  7.     Slump limit.
  8.     Air content.
  9.     Nominal maximum aggregate size.
  10.    Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
  11.    Intended placement method.
- 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.
- D.     Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.
1.     Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.
- E.     Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
1.     Location of construction joints is subject to approval of the Architect.
- F.     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. Waterstops.
  6. Curing compounds.
  7. Vapor retarders.
  8. Semirigid joint filler.
  9. Joint-filler strips.
- G. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
1. Portland cement.
  2. Fly ash.
  3. Slag cement.
  4. Blended hydraulic cement.
  5. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
  6. Admixtures.
- H. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.
- I. Research Reports: For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.
- J. Field quality-control reports.
- K. Minutes of preinstallation conference.

#### 1.5 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 C 94/C 94M 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 C 1077 and ASTM E 329 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/D 1.4M, "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."
- G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- H. Mockups: Cast concrete slab-on-grade panels to demonstrate typical joints, surface finish, texture, tolerances, floor treatments, and standard of workmanship.
  - 1. Build panel approximately 200 sq. ft. for slab-on-grade in the location indicated or, if not indicated, as directed by Architect.
  - 2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- I. Preinstallation Conference: Conduct conference at Project site.
  - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
    - a. Contractor's superintendent.
    - b. Independent testing agency responsible for concrete design mixtures.
    - c. Ready-mix concrete manufacturer.
    - d. Concrete subcontractor.
    - e. Special concrete finish subcontractor.
  - 2. Review special inspection and testing and inspecting agency procedures for field quality control, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, vapor-retarder installation, steel reinforcement installation, floor and slab flatness and levelness measurement, and concrete protection.

#### 1.6 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on each concrete mixture.
  - 1. Include the following information in each test report:
    - a. Admixture dosage rates.

- b. Slump.
- c. Air content.
- d. Seven-day compressive strength.
- e. 28-day compressive strength.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.
- C. Comply with ASTM C94/C94M and ACI 301.

### 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.
  - 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
    - a. High-density overlay, Class 1 or better.
    - b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
    - c. Structural 1, B-B or better; mill oiled and edge sealed.
    - d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
- 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. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.
- E. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch minimum.
- F. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

- G. 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.
- H. 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 to the plane of exposed concrete surface.
  - 2. Furnish ties that, when removed, will leave holes no larger than 1 inch 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 A 615/A 615M, Grade 60, deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
- C. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

## 2.3 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- B. Epoxy-Coated Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, ASTM A 775/A 775M epoxy coated.
- C. 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. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

## 2.4 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
  - 1. Portland Cement: ASTM C 150, Type I/II.
  - 2. Fly Ash: ASTM C 618, Class C or F.
  - 3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33/C33M, 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.

## 2.5 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260/260M.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
  - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
  - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
  - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
  - 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
  - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
  - 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

## 2.6 WATERSTOPS

- A. As Indicated on the drawings.

## 2.7 VAPOR RETARDERS

- A. Sheet Vapor Retarder: ASTM E 1745, Class A, not less than 10mm thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Carlisle Coatings & Waterproofing, Inc.; Blackline 400.
    - b. Fortifiber Building Systems Group; Moistop Ultra.
    - c. Grace Construction Products, W. R. Grace & Co.; Florprufe 120.

- d. Insulation Solutions, Inc.; Viper VaporCheck.
- e. Meadows, W. R., Inc.; Perminator.
- f. Raven Industries Inc.; Vapor Block.
- g. Reef Industries, Inc.; Griffolyn.
- h. Stego Industries, LLC; Stego Wrap.

## 2.8 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
    - b. BASF Construction Chemicals - Building Systems; Kure 200.
    - c. ChemMasters; Safe-Cure Clear.
    - d. Conspec by Dayton Superior; W.B. Resin Cure.
    - e. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
    - f. Edoco by Dayton Superior; Res X Cure WB.
    - g. Euclid Chemical Company (The), an RPM company; Kurez W VOX; TAMMSCURE WB 30C.
    - h. Kaufman Products, Inc.; Thinfilm 420.
    - i. Lambert Corporation; AQUA KURE - CLEAR.
    - j. L&M Construction Chemicals, Inc.; L&M Cure R.
    - k. Meadows, W. R., Inc.; 1100-CLEAR.
    - l. Nox-Crete Products Group; Resin Cure E.
    - m. Right Pointe; Clear Water Resin.
    - n. SpecChem, LLC; Spec Rez Clear.
    - o. Symons by Dayton Superior; Resi-Chem Clear.
    - p. TK Products, Division of Sierra Corporation; TK-2519 DC WB.
    - q. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating.
  - 1. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Anti-Hydro International, Inc.; AH Clear Cure WB.
    - b. BASF Construction Chemicals - Building Systems; Kure-N-Seal WB.
    - c. ChemMasters; Safe-Cure & Seal 20.



- d. Conspec by Dayton Superior; Cure and Seal WB.
  - e. Cresset Chemical Company; Crete-Trete 309-VOC Cure & Seal.
  - f. Dayton Superior Corporation; Safe Cure and Seal (J-18).
  - g. Edoco by Dayton Superior; Spartan Cote WB II.
  - h. Euclid Chemical Company (The), an RPM company; Aqua Cure VOX; Clearseal WB 150.
  - i. Kaufman Products, Inc.; Cure & Seal 309 Emulsion.
  - j. Lambert Corporation; Glazecote Sealer-20.
  - k. L&M Construction Chemicals, Inc.; Dress & Seal WB.
  - l. Meadows, W. R., Inc.; Vocomp-20.
  - m. Metalcrete Industries; Metcure.
  - n. Nox-Crete Products Group; Cure & Seal 150E.
  - o. Symons by Dayton Superior; Cure & Seal 18 Percent E.
  - p. TK Products, Division of Sierra Corporation; TK-2519 WB.
  - q. Vexcon Chemicals, Inc.; Starseal 309.
- F. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. BASF Construction Chemicals - Building Systems; Kure-N-Seal 25 LV.
    - b. ChemMasters; Spray-Cure & Seal Plus.
    - c. Conspec by Dayton Superior; Sealcure 1315.
    - d. Dayton Superior Corporation; Day-Chem Cure and Seal (J-22UV).
    - e. Edoco by Dayton Superior; Cureseal 1315.
    - f. Euclid Chemical Company (The), an RPM company; Super Diamond Clear; LusterSeal 300.
    - g. Kaufman Products, Inc.; Sure Cure 25.
    - h. Lambert Corporation; UV Super Seal.
    - i. L&M Construction Chemicals, Inc.; Lumiseal Plus.
    - j. Meadows, W. R., Inc.; CS-309/30.
    - k. Metalcrete Industries; Seal N Kure 30.
    - l. Right Pointe; Right Sheen 30.
    - m. Vexcon Chemicals, Inc.; Certi-Vex AC 1315.

## 2.9 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber

## 2.10 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. Combined Fly Ash and Pozzolan: 25 percent.
  - 3. Ground Granulated Blast-Furnace Slag: 50 percent.
  - 4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
  - 5. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete 1.00 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
  - 1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
  - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
  - 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.
  - 4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

## 2.11 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Building Footings: Proportion normal-weight concrete mixture as follows:
  - 1. Minimum Compressive Strength: 4000 psi at 28 days.
  - 2. Maximum Water-Cementitious Materials Ratio: 0.52
  - 3. Slump Limit: 3 inches plus or minus 1 inch.
  - 4. Air Content: 6 percent, plus or minus 2 percent at point of delivery for coarse aggregate size.
- B. Foundation Walls: Proportion normal-weight concrete mixture as follows:
  - 1. Minimum Compressive Strength: 4000 psi at 28 days.
  - 2. Maximum Water-Cementitious Materials Ratio: 0.52
  - 3. Slump Limit: 3 inches plus or minus 1 inch.
  - 4. Air Content: 6 percent, plus or minus 2 percent at point of delivery for coarse aggregate size.
- C. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:
  - 1. Minimum Compressive Strength: 4000 psi at 28 days.
  - 2. Maximum Water-Cementitious Materials Ratio: 0.46
  - 3. Slump Limit: 3 inches plus or minus 1 inch.
  - 4. Air Content: Not Required

- D. Suspended Slabs: Proportion normal-weight concrete mixture as follows:
  - 1. Minimum Compressive Strength: 4000 psi at 28 days.
  - 2. Maximum Water-Cementitious Materials Ratio: 0.46
  - 3. Slump Limit: 4 inches plus or minus 1 inch.
  - 4. Air Content: 5.5%, plus or minus 1.5% at point of delivery for 1-1/2-inch nominal maximum aggregate size, 6%, plus or minus 1.5% at point of delivery for 1-inch nominal maximum aggregate size

## 2.12 FABRICATING REINFORCEMENT

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

## 2.13 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
  - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
  - 1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
  - 2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
  - 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

## 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 347 as abrupt or gradual, as follows:
  - 1. Class A, 1/8 inch for smooth-formed finished surfaces.
  - 2. Class B, 1/4 inch or better 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."
  - 2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
  - 3. Install dovetail anchor slots in concrete structures as indicated.

### 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 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 SHORES AND RESHORES

- A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
  - 1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
- B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.
- C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

### 3.5 VAPOR RETARDERS

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
  - 1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
  - 2. Face laps away from exposed direction of concrete pour.
  - 3. Lap vapor retarder over footings and grade beams not less than 6 inches, sealing vapor retarder to concrete.
  - 4. Lap joints 6 inches and seal with manufacturer's recommended tape.
  - 5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
  - 6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.

7. Protect vapor retarder during placement of reinforcement and concrete.

### 3.6 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
  1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- 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/D 1.4M, 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 D 3963/D 3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.
- G. Zinc-Coated Reinforcement: Repair cut and damaged zinc coatings with zinc repair material according to ASTM A 780. Use galvanized steel wire ties to fasten zinc-coated steel reinforcement.

### 3.7 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. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
  3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
  4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.

5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
  6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
  7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth shown on drawings as follows:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
  2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
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 or more than 1 inch 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 dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

### 3.8 WATERSTOPS

- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.
- B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

### 3.9 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
  - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. 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 inches 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.
- E. 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.
- F. Cold-Weather Placement: Comply with ACI 306.1 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 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.
- G. Hot-Weather Placement: Comply with ACI 301 and as follows:



1. Maintain concrete temperature below 90 deg F 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.

### 3.10 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.
- 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.
- C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
  1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
  2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
  3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.
- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

### 3.11 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
  - 1. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:
    - a. Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.
    - b. 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.
    - c. Specified overall values of flatness, F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 15; for suspended slabs.
    - d. Specified overall values of flatness, F(F) 45; and of levelness, F(L) 35; with minimum local values of flatness, F(F) 30; and of levelness, F(L) 24.
  - 2. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.-long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/4 inch.
- E. 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 before application.

### 3.12 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: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

### 3.13 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. 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 308.1, 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 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 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
    - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
    - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
    - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

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. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a 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. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

### 3.14 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.
- B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
  1. Testing agency shall be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
  2. Testing agency shall immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
  3. Testing agency shall report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
- C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.
- D. 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.
  8. Batch Plant Inspections: On a random basis, as determined by Architect.

- E. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. Yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
  2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. 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.
  3. Slump: ASTM C 143/C 143M; 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.
  4. Air Content: ASTM C 231, 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.
  5. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
  6. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
  7. Compression Test Specimens: ASTM C 31/C 31M.
    - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
    - b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.
  8. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
    - a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
    - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
  9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
  10. 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.
  11. Test results shall be reported in writing to Architect, 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.

12. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
13. 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. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
14. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
15. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

- F. Measure floor and slab flatness and levelness according to ASTM E 1155 within 48 hours of finishing.

### 3.15 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 033000

## SECTION 042200 - CONCRETE UNIT MASONRY

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Steel reinforcing bars.

#### 1.2 DEFINITIONS

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For reinforcing steel. Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each type and size of product. For masonry units, include data on material properties.
- B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
  - 1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
  - 2. Include test reports, according to ASTM C1019, for grout mixes required to comply with compressive strength requirement.

#### 1.5 FIELD CONDITIONS

- A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
- B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

### PART 2 - PRODUCTS

#### 2.1 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.



2.2 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
  - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
- B. CMUs: ASTM C90.
  - 1. Density Classification: Normal weight.

2.3 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- B. Hydrated Lime: ASTM C207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. Aggregate for Mortar: ASTM C144.
- E. Aggregate for Grout: ASTM C404.
- F. 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.
- G. Water: Potable.

## 2.4 REINFORCEMENT

- A. Uncoated-Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60.
- B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
- C. Masonry-Joint Reinforcement, General: ASTM A951/A951M.
  - 1. Interior Walls: Hot-dip galvanized, carbon steel.
  - 2. Exterior Walls: Hot-dip galvanized carbon steel.
  - 3. Wire Size for Side Rods: 0.1875-inch diameter.
  - 4. Wire Size for Cross Rods: 0.1875-inch diameter.
  - 5. Spacing of Cross Rods: Not more than 16 inches o.c.
  - 6. Provide in lengths of not less than 10 feet.

## 2.5 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from urethane.
- B. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).

## 2.6 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
  - 1. Do not use calcium chloride in mortar or grout.
  - 2. Use portland cement-lime mortar unless otherwise indicated.
- B. Mortar for Unit Masonry: Comply with ASTM C270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated.
  - 1. For masonry below grade or in contact with earth, use Type S.
  - 2. For reinforced masonry, use Type S.
  - 3. For exterior, above-grade, load-bearing and nonload-bearing walls and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type S.
- C. Grout for Unit Masonry: Comply with ASTM C476.
  - 1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
  - 2. Proportion grout in accordance with ASTM C476, Table 1.
  - 3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C143/C143M.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp,

unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

### 3.2 TOLERANCES

#### A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

#### B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.

#### C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
3. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

### 3.3 LAYING MASONRY WALLS

- #### A.
- Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- D. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- E. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.
- F. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

### 3.4 MORTAR BEDDING AND JOINTING

- A. Lay hollow CMUs as follows:
  - 1. Bed face shells in mortar and make head joints of depth equal to bed joints.
  - 2. Bed webs in mortar in all courses of piers, columns, and pilasters.
  - 3. Bed webs in mortar in grouted masonry, including starting course on footings.
  - 4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
- B. Lay solid CMUs with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

### 3.5 MASONRY-JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
  - 1. Space reinforcement not more than 16 inches o.c.
  - 2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.

3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.

### 3.6 REINFORCED UNIT MASONRY

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
  1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
  2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and that of other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
  1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
  2. Limit height of vertical grout pours to not more than 48 inches.

### 3.7 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
- B. Inspections: Special inspections according to Level B in TMS 402/ACI 530/ASCE 5.
  - 1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
  - 2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
  - 3. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Prior to Construction: One set of tests.
- D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.
- E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C140 for compressive strength.
- F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C780.



- G. Mortar Test (Property Specification): For each mix provided, according to ASTM C780. Test mortar for compressive strength.
- H. Grout Test (Compressive Strength): For each mix provided, according to ASTM C1019.

3.8 REPAIRING, POINTING, AND CLEANING

- A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
  - 1. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
  - 2. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

3.9 MASONRY WASTE DISPOSAL

- A. Masonry Waste: Remove clean masonry waste and legally dispose of off Owner's property.

END OF SECTION 042200

## SECTION 051200 - STRUCTURAL STEEL FRAMING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Structural steel.
  - 2. Grout.
- B. Related Sections:
  - 1. Division 01 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
  - 2. Division 05 Section "Steel Decking" for field installation of shear connectors through deck.

#### 1.3 DEFINITIONS

- A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
- B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.
- C. Demand Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the Seismic-Load-Resisting System and which are indicated as "Demand Critical" or "Seismic Critical" on Drawings.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator, including comprehensive engineering design by a qualified professional engineer, to withstand loads indicated and comply with other information and restrictions indicated.
  - 1. Select and complete connections using structural drawings and end reactions as tabulated in the AISC 360 steel manual.
  - 2. Use LRFD or ASD.

- B. Moment Connections: Type FR, fully restrained.
- C. Construction: Combined system of moment frame, braced frame, and knee braces.

#### 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- 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.
  - 5. Identify members and connections of the seismic-load-resisting system.
  - 6. Indicate locations and dimensions of protected zones.
  - 7. Identify demand critical welds.
  - 8. For structural-steel connections indicated to comply with design loads, include structural design data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing, including the following:
  - 1. Power source (constant current or constant voltage).
  - 2. Electrode manufacturer and trade name, for demand critical welds.
- D. Qualification Data: For qualified Installer.
- E. Welding certificates.
- F. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- G. Mill test reports for structural steel, including chemical and physical properties.
- H. 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. Nonshrink grout.
  - 6. Shop primers.
  - 7. Tension rods, turnbuckles, clevises, and other connectors.

- I. Source quality-control reports.

#### 1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.
- B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category ACSE.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.
- D. Comply with applicable provisions of the following specifications and documents:
  - 1. AISC 303.
  - 2. AISC 341 and AISC 341s1.
  - 3. AISC 360.
  - 4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- E. Preinstallation Conference: Conduct conference at Project site.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

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

## 1.8 COORDINATION

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

## PART 2 - PRODUCTS

### 2.1 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A 992, Grade 50.
- B. Channels, Angles, S-Shapes: ASTM A 36, Grade 36.
- C. Plate and Bar: ASTM A 36, Grade 36.
- D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade C, structural tubing.
- E. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
- F. Welding Electrodes: Comply with AWS requirements.

### 2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, (ASTM A 563M, Class 8S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers; all with plain finish.
  - 1. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with plain finish.
- B. Unheaded Anchor Rods: ASTM F 1554, Grade 55, weldable.
  - 1. Configuration: Straight.
  - 2. Nuts: ASTM A 563 hex carbon steel.
  - 3. Plate Washers: ASTM A 36/A 36M carbon steel.
  - 4. Washers: ASTM F 436, Type 1, hardened carbon steel.
  - 5. Finish: Plain.
- C. Headed Anchor Rods: ASTM F 1554, Grade 55, weldable, straight.
  - 1. Nuts: ASTM A 563 hex carbon steel.
  - 2. Plate Washers: ASTM A 36/A 36M carbon steel.
  - 3. Washers: ASTM F 436, Type 1, hardened carbon steel.
  - 4. Finish: Plain.

D. Threaded Rods: ASTM A 36/A 36M.

1. Nuts: ASTM A 563 hex carbon steel.
2. Washers: ASTM F 436, Type 1, hardened
3. Finish: Plain.

E. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1035.

F. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.

G. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1018.

2.3 PRIMER

A. Steel Primer:

1. Fabricator's standard lead- and chromate-free, non-asphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

2.4 GROUT

- A. Metallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.
- B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.5 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.
1. Camber structural-steel members where indicated.
  2. Fabricate beams with rolling camber up.
  3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
  4. Mark and match-mark materials for field assembly.
  5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. 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.
- F. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural steel. Straighten as required to provide uniform, square, and true members in completed wall framing.
- G. Welded Door Frames: Build up welded door frames attached to structural steel. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk machine screws, uniformly spaced not more than 10 inches o.c. unless otherwise indicated.
- H. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.
  - 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
  - 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
  - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

## 2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
  - 1. Joint Type: Snug tightened.
- 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. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

## 2.7 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
  - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
  - 2. Surfaces to be field welded.
  - 3. Surfaces to be high-strength bolted with slip-critical connections.
  - 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
  - 5. Galvanized surfaces.

- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
  - 1. SSPC-SP 2, "Hand Tool Cleaning."
  - 2. SSPC-SP 3, "Power Tool Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
  - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
  - 2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.
- D. 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.

## 2.8 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.
  - 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- C. Bolted Connections: Shop-bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
  - 1. Liquid Penetrant Inspection: ASTM E 165.
  - 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
  - 3. Ultrasonic Inspection: ASTM E 164.
  - 4. Radiographic Inspection: ASTM E 94.
- E. In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
  - 1. Bend tests will be performed if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.



2. Tests will be conducted on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.

### 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 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.
  1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

#### 3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Base Bearing and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials and roughen surfaces prior to setting plates. Clean bottom surface of plates.
  1. Set plates for structural members on wedges, shims, or setting nuts as required.
  2. 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's "Code of Standard Practice for Steel Buildings and Bridges."

- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
  - 1. Level and plumb individual members of structure.
  - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection.
- 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 ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
  - 1. Joint Type: Snug tightened.
- 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, back gouge, and grind steel smooth.
  - 3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

### 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high strength bolted connections.
- B. Bolted Connections: Bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Field welds will be visually inspected according to AWS D1.1/D1.1M.
  - 1. In addition to visual inspection, field welds will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
    - a. Liquid Penetrant Inspection: ASTM E 165.

- b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
  - c. Ultrasonic Inspection: ASTM E 164.
  - d. Radiographic Inspection: ASTM E 94.
- D. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
  - 1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
  - 2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.
- E. 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 A 780.
- 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.
- C. Touchup Painting: Cleaning and touchup painting are specified in Division 09 painting Sections.

END OF SECTION 051200

## SECTION 053100 - STEEL DECKING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Roof deck.
  - 2. Composite floor deck.
- B. Related Sections include the following:
  - 1. Division 03 Section "Cast-in-Place Concrete" for concrete fill.
  - 2. Division 05 Section "Structural Steel Framing" for shop- and field-welded shear connectors.
  - 3. Division 05 Section "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.
  - 4. Division 09 painting Sections for repair painting of primed deck.

#### 1.3 SUBMITTALS

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

- C. Product Certificates: For each type of steel deck, signed by product manufacturer.
- D. Welding certificates.
- E. Field quality-control test and inspection reports.
- F. 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.
- G. Research/Evaluation Reports: For steel deck.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency qualified according to ASTM E 329 for testing indicated.
- B. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."
- C. Fire-Test-Response Characteristics: Where indicated, provide steel deck units identical to those tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance Ratings: Indicated by design designations of applicable testing and inspecting agency.
  2. Steel deck units shall be identified with appropriate markings of applicable testing and inspecting agency.
- D. 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."
- E. FMG Listing: Provide steel roof deck evaluated by FMG and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.
- F. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
- 1.5 DELIVERY, STORAGE, AND HANDLING
- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Steel Deck:

- a. ASC Profiles, Inc.
- b. Canam Steel Corp.; The Canam Manac Group.
- c. Consolidated Systems, Inc.
- d. DACS, Inc.
- e. D-Mac Industries Inc.
- f. Epic Metals Corporation.
- g. Marlyn Steel Decks, Inc.
- h. New Millennium Building Systems, LLC.
- i. Nucor Corp.; Vulcraft Division.
- j. Roof Deck, Inc.
- k. United Steel Deck, Inc.
- l. Valley Joist; Division of EBSCO Industries, Inc.
- m. Vercor Manufacturing Co.
- n. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

2.2 ROOF DECK

- A. Steel Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 30, and with the following:

1. Prime-Painted Steel Sheet: ASTM A 1008/A 1008M, Structural Steel (SS), Grade 50 (345) minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
  - a. Color: Manufacturer's standard.
2. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 50 (345), G60 (Z180) zinc coating.
3. Galvanized and Shop-Primed Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 50 (345), G60 (Z180) zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.
  - a. Color: Manufacturer's standard.
4. Deck Profile: As indicated.
5. Profile Depth: As indicated.
6. Design Uncoated-Steel Thickness: As indicated.
7. Span Condition: Triple span or more.
8. Side Laps: Overlapped.

## 2.3 COMPOSITE FLOOR DECK

- A. Composite Steel Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 30, with the minimum section properties indicated, and with the following:
  - 1. Prime-Painted Steel Sheet: ASTM A 1008/A 1008M, Structural Steel (SS), Grade 33 minimum, with top surface phosphatized and unpainted and underside surface shop primed with manufacturers' standard baked-on, rust-inhibitive primer.
  - 2. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33 zinc coating.
  - 3. Galvanized and Shop-Primed Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33 zinc coating; with unpainted top surface and cleaned and pretreated bottom surface primed with manufacturer's standard baked-on, rust-inhibitive primer.
  - 4. Profile Depth: As indicated.
  - 5. Design Uncoated-Steel Thickness: As indicated.
  - 6. Span Condition: As indicated.

## 2.4 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 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, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 30 for overhang and slab depth.
- G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.
- H. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.
- I. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch thick, with factory-punched hole of 3/8-inch minimum diameter.
- J. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch- wide flanges and level recessed pans of 1-1/2-inch minimum depth. For drains, cut holes in the field.
- K. Flat Sump Plate: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.
- L. Galvanizing Repair Paint: ASTM A 780, SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight.
- M. 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.

#### 3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 30, 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.
  - 1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.
- 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.
- 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 inches (38 mm) long, and as follows:
  - 1. Weld Diameter: As indicated.
  - 2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space as indicated.
  - 3. Weld Washers: Install weld washers at each weld location.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of 1/2 of the span or indicated spacing, and as follows:
  - 1. Mechanically fasten with self-drilling, No. 10 (4.8-mm-) diameter or larger, carbon-steel screws.
  - 2. Mechanically clinch or button punch.
  - 3. Fasten with a minimum of 1-1/2-inch- (38-mm-) long welds.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm), with end joints as follows:
  - 1. End Joints: Lapped 2 inches (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 inches (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 independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field welds will be subject to inspection.
- C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.
- D. Remove and replace work that does not comply with specified requirements.
- E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

### 3.5 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
  - 1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
  - 2. Wire brushing, cleaning, and repair painting of bottom deck surfaces are included in Division 09 Section "Interior Painting."

- C. Repair Painting: Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in Division 09 Section "Interior Painting."
- D. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 053100

## PART 1 - GENERAL

### 1.1 SUMMARY

#### A. Section Includes:

1. Exterior non-load-bearing wall framing.

### 1.2 ACTION SUBMITTALS

#### A. Product Data: For the following:

1. Cold-formed steel framing materials.
2. Exterior non-load-bearing wall framing.
3. Vertical deflection clips.
4. Single deflection track.
5. Double deflection track.
6. Drift clips.
7. Post-installed anchors.
8. Power-actuated anchors.

#### B. Shop Drawings:

1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
3. Delegated Design Submittal: For Exterior Wall cold formed metal framing comply with design loads indicated on Dwg S-001, and provide analysis data signed and sealed by the qualified professional engineer licensed in New York responsible for their preparation.

### 1.3 INFORMATIONAL SUBMITTALS

#### A. Welding certificates.

#### B. Product certificates.

#### C. Product test reports.

#### D. Research Reports:

1. For post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

#### 1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.
- B. Product Tests: Mill certificates or data from a qualified independent testing agency.
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
  1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

#### 1.5 PERFORMANCE REQUIREMENTS

- A. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing shall comply with AISI S100, AISI S200, and the following:
  1. Wall Studs: AISI S211.
  2. Headers: AISI S212.
  3. Lateral Design: AISI S213.

#### 1.6 COLD-FORMED STEEL FRAMING MATERIALS

- A. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:
  1. Grade: As required by structural performance.
  2. Coating: G60, or equivalent
- B. Steel Sheet for Vertical Deflection Drift Clips: ASTM A653/A653M, structural steel, zinc coated, of grade and coating as follows:
  1. Grade As required by structural performance.
  2. Coating: G60.

#### 1.7 EXTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and matching minimum base-metal thickness of steel studs.

- C. Vertical Deflection Clips: Manufacturer's standard head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
- D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure.
- E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.
- F. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

#### 1.8 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated.

#### 1.9 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.
- B. Anchor Bolts: ASTM F1554, Grade 36, threaded carbon-steel hex-headed bolts, carbon-steel nuts, and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A153/A153M, Class C.
- C. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, as appropriate for the substrate.



- D. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- E. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
  - 1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

#### 1.10 MISCELLANEOUS MATERIALS

- A. Shims: Load bearing, high-density, multimonomer, non-leaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.
- B. Sill Sealer Gasket: Closed-cell neoprene foam, 1/4 inch (6 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members as required.

### PART 2 - EXECUTION

#### 2.1 PREPARATION

- A. Install sill sealer gasket at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

#### 2.2 INSTALLATION, GENERAL

- A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
- D. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

- E. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- F. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.
- G. Install insulation, specified in Section 072100 "Thermal Insulation," in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, which are inaccessible on completion of framing work.
- H. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

## 2.3 INSTALLATION OF EXTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.
- B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:
  - 1. Stud Spacing: 16 inches on center.
- C. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
  - 1. Install single deep-leg deflection tracks and anchor to building structure.
  - 2. Install double deep-leg deflection tracks and anchor outer track to building structure.
  - 3. Connect vertical deflection clips to infill studs and anchor to building structure.
  - 4. Connect drift clips to cold-formed steel framing and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated but not more than 48 inches apart. Fasten at each stud intersection.
  - 1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.

2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
  3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 18 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
1. Install solid blocking at centers indicated on Shop Drawings.
- G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

## 2.4 INSTALLATION TOLERANCES

- A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

## 2.5 REPAIRS

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

## 2.6 FIELD QUALITY CONTROL

- A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field and shop welds will be subject to testing and inspecting.
- C. Testing agency will report test results promptly and in writing to Contractor and Architect.
- D. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

END OF SECTION 054000

## SECTION 055000 - METAL FABRICATIONS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Miscellaneous framing and supports.
2. Metal ladders.
3. Metal bollards.

B. Products furnished, but not installed, under this Section include the following:

1. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

C. Related Requirements:

1. Section 042000 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
2. Section 051200 "Structural Steel Framing" for steel framing, supports, elevator machine beams, hoist beams, divider beams, door frames, and other steel items attached to the structural-steel framing.

#### 1.2 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

#### 1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Fasteners.
2. Shop primers.
3. Shrinkage-resisting grout.
4. Manufactured metal ladders.
5. Metal bollards.

- B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:

1. Miscellaneous framing and supports for applications where framing and supports are not specified in other Sections.
2. Shelf angles.
3. Metal ladders.
4. Miscellaneous steel trim including steel angle corner guards, steel edgings and loading-dock edge angles.
5. Metal bollards.
6. Loose steel lintels.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Certificates:

1. Welding certificates.
2. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

- B. Research Reports: For post-installed anchors.

#### 1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

#### 1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F , ambient; 180 deg F , material surfaces.

## 2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- C. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.
- D. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.

## 2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 316 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
  - 1. Provide stainless steel fasteners for fastening aluminum, stainless steel or nickel silver.
  - 2. Provide bronze fasteners for fastening bronze.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.
- C. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325 (Grade A325M), Type 3, heavy-hex steel structural bolts; ASTM A563, Grade DH3, (ASTM A563M, Class 10S3) heavy-hex carbon-steel nuts; and where indicated, flat washers.
- D. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593 (ISO 3506-1); with hex nuts, ASTM F594 (ASTM F836M); and, where indicated, flat washers; Alloy Group 1
- E. Anchor Bolts: ASTM F1554, Grade 55, of dimensions indicated; with nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.
  - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- F. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.
- G. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329/F2329M.
- H. Post-Installed Anchors: Torque-controlled expansion anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 stainless steel bolts, ASTM F593 (ISO 3506-1), and nuts, ASTM F594 (ASTM F836M).

## 2.4 MISCELLANEOUS MATERIALS

- A. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- B. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- D. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

## 2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
  1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
  4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches (3.2 by 38 mm), with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.

## 2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
- C. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

## 2.7 METAL LADDERS

- A. General:
  - 1. Comply with ANSI A14.3.
- B. Steel Ladders:
  - 1. Siderails: Continuous steel flat bars, with eased edges.
  - 2. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
  - 3. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
  - 4. Provide platforms as indicated fabricated from welded or pressure-locked steel bar grating, supported by steel angles. Limit openings in gratings to no more than 1/2 inch (12 mm) in least dimension.
  - 5. Galvanize and prime ladders, including brackets.
  - 6. Prime ladders, including brackets and fasteners, with zinc-rich primer.



2.8 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
  - 1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.
- C. Galvanize and prime miscellaneous steel trim.
- D. Prime miscellaneous steel trim with zinc-rich primer.

2.9 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.10 GENERAL FINISH REQUIREMENTS

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.11 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
  - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean galvanized surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
- D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
  - 1. Cast Aluminum: Heavy coat of bituminous paint.
  - 2. Extruded Aluminum: Two coats of clear lacquer.

### 3.2 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Anchor supports for overhead doors securely to, and rigidly brace from, building structure.
- C. Anchor shelf angles securely to existing construction with expansion anchors.

- D. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
  - 1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.
- E. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installation of Bearing and Leveling Plates" Article.
  - 1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

### 3.3 INSTALLATION OF SHELF ANGLES

- A. Install shelf angles as required to keep masonry level, at correct elevation, and flush with vertical plane.

### 3.4 INSTALLATION OF METAL LADDERS

- A. Secure ladders to adjacent construction with the clip angles attached to the stringer.
- B. Install brackets as required for securing of ladders welded or bolted to structural steel or built into masonry or concrete.

### 3.5 INSTALLATION OF MISCELLANEOUS STEEL TRIM

- A. Anchor to concrete construction to comply with manufacturer's written instructions.

### 3.6 INSTALLATION OF METAL BOLLARDS

- A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.
  - 1. Do not fill removable bollards with concrete.

### 3.7 REPAIRS

- A. Touchup Painting:
  - 1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
    - a. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in other sections.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055000

## SECTION 055113 - METAL PAN STAIRS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Preassembled steel stairs with concrete-filled treads.
2. Steel tube railings and guards attached to metal stairs.
3. Steel tube handrails attached to walls adjacent to metal stairs.

#### 1.2 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

#### 1.3 ACTION SUBMITTALS

A. Shop Drawings:

1. Include plans, elevations, sections, details, and attachments to other work.
2. Indicate sizes of metal sections, thickness of metals, profiles, holes, and field joints.
3. Include plan at each level.
4. Indicate locations of anchors, weld plates, and blocking for attachment of wall-mounted handrails.

- B. Delegated Design Submittal: For stairs railings, and guards, including analysis data signed and sealed by the qualified professional engineer, licensed in New York State responsible for their preparation.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer's experience with providing delegated design engineering services of the kind indicated, including documentation that engineer is licensed in the State in which Project is located.
- B. Welding certificates.

#### 1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design stairs, railings, and guards including attachment to building construction.
- B. Structural Performance of Stairs: Metal stairs withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Uniform Load: 100 lbf/sq. ft..

2. Concentrated Load: 300 lbf applied on an area of 4 sq. in..
  3. Uniform and concentrated loads need not be assumed to act concurrently.
  4. Stair Framing: Capable of withstanding stresses resulting from railing and guard loads in addition to loads specified above.
  5. Limit deflection of treads, platforms, and framing members to  $L/360$  or  $1/4$  inch, whichever is less.
- C. Structural Performance of Railings and Guards: Railings and guards, including attachment to building construction, withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
1. Handrails and Top Rails of Guards:
    - a. Uniform load of 50 lbf/ft. applied in any direction.
    - b. Concentrated load of 200 lbf applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
  2. Infill of Guards:
    - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
    - b. Infill load and other loads need not be assumed to act concurrently.
  3. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

## 2.2 METALS

- A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- B. Steel Pipe for Railings and Guards: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
  1. Provide galvanized finish for exterior installations and where indicated.
- C. Uncoated, Cold-Rolled Steel Sheet: ASTM A1008/A1008M, either commercial steel, Type B, or structural steel, Grade 25, unless another grade is required by design loads; exposed.
- D. Uncoated, Hot-Rolled Steel Sheet: ASTM A1011/A1011M, either commercial steel, Type B, or structural steel, Grade 30, unless another grade is required by design loads.

## 2.3 FASTENERS

- A. General: Provide zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5 where built into exterior walls.
  1. Select fasteners for type, grade, and class required.
- B. Fasteners for Anchoring Railings and Guards to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings and guards to other types of construction indicated and capable of withstanding design loads.

- C. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.



1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.

## 2.4 MISCELLANEOUS MATERIALS

- A. Handrail Wall Brackets: Cast nickel-silver, center of rail 2-1/2 inches from face of wall.
- B. Zinc-Rich Primer: Comply with SSPC-Paint 20, Type II, Level 2, and compatible with topcoat.
- C. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout; recommended by manufacturer for interior use; noncorrosive and nonstaining; mixed with water to consistency suitable for application and a 30-minute working time.

## 2.5 FABRICATION, GENERAL

- A. Provide complete stair assemblies, including metal framing, struts, railings, and guards, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms to supporting structure.
  1. Join components by welding unless otherwise indicated.
  2. Use connections that maintain structural value of joined pieces.
- B. Assemble stairs, railings, and guards in shop to greatest extent possible.
  1. Disassemble units only as necessary for shipping and handling limitations.
  2. Clearly mark units for reassembly and coordinated installation.
- C. Cut, drill, and punch metals cleanly and accurately.
  1. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.
  2. Remove sharp or rough areas on exposed surfaces.

- D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Form exposed work with accurate angles and surfaces and straight edges.
- F. Weld connections to comply with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. Weld exposed corners and seams continuously unless otherwise indicated.
  - 5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #2 - Completely sanded joint with some undercutting and pinholes okay.
- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.
  - 1. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated.
  - 2. Locate joints where least conspicuous.

## 2.6 FABRICATION OF STEEL-FRAMED STAIRS

- A. NAAMM Stair Standard: Comply with NAAMM AMP 510, "Metal Stairs Manual," for Commercial Class, unless more stringent requirements are indicated.
- B. Stair Framing:
  - 1. Stringers: Fabricate stringers of steel channels.
    - a. Stringer Size: As required to comply with "Performance Requirements" Article.
    - b. Provide closures for exposed ends of channel and rectangular tube stringers.
    - c. Finish: Shop primed.

2. Platforms: Construct of steel channel or steel rectangular tube headers and miscellaneous framing members as required to comply with "Performance Requirements" Article.
    - a. Provide closures for exposed ends of channel and rectangular tube framing.
    - b. Finish: Shop primed.
  3. Weld or bolt stringers to headers; weld or bolt framing members to stringers and headers. If using bolts, fabricate and join so bolts are not exposed on finished surfaces.
- C. Metal Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements, but not less than 0.067 inch.
1. Steel Sheet: Uncoated, cold or hot-rolled steel sheet.
  2. Directly weld metal pans to stringers; locate welds on top of subtreads where they will be concealed by concrete fill. Do not weld risers to stringers.
  3. Attach risers and subtreads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting, or bolting.
  4. Shape metal pans to include nosing integral with riser.

## 2.7 FABRICATION OF STAIR RAILINGS AND GUARDS

- A. Fabricate railings and guards to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of member, post spacings, wall bracket spacing, and anchorage, but not less than that needed to withstand indicated loads.
  - 1. Rails and Posts: 1-5/8-inch-diameter top and bottom rails and posts.
  - 2. Picket Infill: 1/2-inch- square pickets spaced to prohibit the passage of a 4-inch diameter sphere.
- B. Welded Connections: Fabricate railings and guards with welded connections.
  - 1. Cope components at connections to provide close fit, or use fittings designed for this purpose.
  - 2. Weld all around at connections, including at fittings.
  - 3. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 4. Obtain fusion without undercut or overlap.
  - 5. Remove flux immediately.
  - 6. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #2 - Completely sanded joint, some undercutting and pinholes are okay \as shown in NAAMM AMP 521.
- C. Form changes in direction of railings and guards as follows:
  - 1. As detailed.
  - 2. By bending.
- D. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

- E. Close exposed ends of railing and guard members with prefabricated end fittings.
- F. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.
  - 1. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.
- G. Connect posts to stair framing by direct welding unless otherwise indicated.
- H. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work.
  - 1. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.
  - 2. Provide ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.
  - 3. Provide type of bracket with predrilled hole for exposed bolt anchorage and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.
- I. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports.
  - 1. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

## 2.8 FINISHES

- A. Finish metal stairs after assembly.
- B. Preparation for Shop Priming: Prepare uncoated, ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."
- C. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF METAL PAN STAIRS

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction.
  - 1. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- C. Fit exposed connections accurately together to form hairline joints.
  - 1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
  - 2. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
  - 3. Comply with requirements for welding in "Fabrication, General" Article.
- D. Place and finish concrete fill for treads and platforms to comply with Section 033000 "Cast-in-Place Concrete."

### 3.2 INSTALLATION OF RAILINGS AND GUARDS

- A. Adjust railing and guard systems before anchoring to ensure matching alignment at abutting joints with tight, hairline joints.
  - 1. Space posts at spacing indicated or, if not indicated, as required by design loads.
  - 2. Plumb posts in each direction, within a tolerance of 1/16 inch in 3 feet.
  - 3. Align rails and guards so variations from level for horizontal members and variations from parallel with rake of stairs for sloping members do not exceed 1/4 inch in 12 feet.
  - 4. Secure posts, rail ends, and guard ends to building construction as follows:
    - a. Anchor posts to steel by welding to steel supporting members.
    - b. Anchor handrail and guards ends to masonry with steel round flanges welded to rail and guard ends and anchored with post-installed anchors and bolts.
- B. Attach handrails to wall with wall brackets.
  - 1. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
  - 2. Secure wall brackets to building construction as required to comply with performance requirements.

END OF SECTION 055113

## SECTION 061000 - ROUGH CARPENTRY

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Wood blocking and nailers.
  - 2. Plywood backing panels.

#### 1.2 ACTION SUBMITTALS

- A. Product Data:
  - 1. For each type of process and factory-fabricated product.
  - 2. For preservative-treated wood products.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Material Certificates:
  - 1. For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
  - 2. For preservative-treated wood products. Indicate type of preservative used and net amount of preservative retained.
- B. Evaluation Reports: For the following, from ICC-ES:
  - 1. Wood-preservative-treated wood.
  - 2. Fire-retardant-treated wood.

### PART 2 - PRODUCTS

#### 2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: Comply with DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
  - 1. Factory mark each piece of lumber with grade stamp of grading agency.
  - 2. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content:

1. Dimension Lumber: 19 percent unless otherwise indicated.

## 2.2 PRESERVATIVE TREATMENT

- A. Preservative Treatment by Pressure Process: AWP A U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground.
  1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.



D. Application: Treat items indicated on Drawings, and the following:

1. Wood nailers, curbs, equipment support bases, blocking, and similar members in connection with roofing, flashing, and waterproofing.

## 2.3 FIRE-RETARDANT-TREATMENT

- A. General: Where fire-retardant-treated materials are indicated, materials are to comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
1. Interior Type A: Treated materials are to have a moisture content of 28 percent or less when tested according to ASTM D3201/D3201M at 92 percent relative humidity. Use where exterior type is not indicated.
- C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent.
- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
- E. Application: Treat items indicated on Drawings, and the following:
1. Plywood backing panels.

## 2.4 MISCELLANEOUS LUMBER

- A. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
  - 1. Blocking.
  - 2. Nailers.
- B. Dimension Lumber Items: Construction or No. 2 grade lumber of any species.

## 2.5 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: Plywood, DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

## 2.6 FASTENERS

- A. General: Fasteners are to be of size and type indicated and comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches into wood substrate.
- B. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- C. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 ICC-ES AC58 ICC-ES AC193 or ICC-ES AC308 as appropriate for the substrate.

## 2.7 METAL FRAMING ANCHORS

- A. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G60 coating designation.
  - 1. Use for interior locations unless otherwise indicated.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- C. Comply with AWPAC M4 for applying field treatment to cut surfaces of preservative-treated lumber.
- D. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- E. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
  - 1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).
  - 2. ICC-ES evaluation report for fastener.

#### 3.2 PROTECTION

- A. Protect rough carpentry from weather.

END OF SECTION 061000

## SECTION 061600 - SHEATHING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Wall sheathing.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product.

### PART 2 - PRODUCTS

#### 2.1 WALL SHEATHING

- A. Glass-Mat Gypsum Sheathing, Walls: ASTM C1177/C1177M.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. CertainTeed; SAINT-GOBAIN.
  - b. Georgia-Pacific Gypsum LLC.
  - c. Gold Bond Building Products, LLC provided by National Gypsum Company.
  - d. USG Corporation.

2. Type and Thickness: Regular, 1/2 inch thick.

## 2.2 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
  1. For wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.

## 2.3 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

- A. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.
  1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches wide, 10 by 10 or 10 by 20 threads/inch, of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
  1. Table 2304.10.1, "Fastening Schedule," in the ICC's International Building Code.
  2. ICC-ES evaluation report for fastener.

- D. Coordinate wall sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

### 3.2 GYPSUM SHEATHING INSTALLATION

- A. Comply with GA-253 and with manufacturer's written instructions.
  - 1. Fasten gypsum sheathing to cold-formed metal framing with screws.
  - 2. Install panels with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
  - 3. Install panels with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- B. Seal sheathing joints in accordance with sheathing manufacturer's written instructions.
  - 1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
  - 2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

END OF SECTION 061600

## SECTION 072726 - FLUID-APPLIED MEMBRANE AIR BARRIERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Vapor-retarding, fluid-applied air barriers.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For air-barrier assemblies.

1. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.

#### 1.3 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Product test reports.

C. Field quality-control reports.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

### PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

- A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction to be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies to be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.
- B. Air Permeance: Maximum 0.009 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. pressure difference; ASTM E2178.
- C. Ultimate Elongation: Minimum 1,000 percent; ASTM D412, Die C.
- D. Adhesion to Substrate: Minimum 28 lbf/sq. in. when tested in accordance with ASTM D4541.
- E. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
- F. UV Resistance: Can be exposed to sunlight for 30 days in accordance with manufacturer's written instructions.

## 2.2 HIGH-BUILD AIR BARRIERS, VAPOR RETARDING

- A. High-Build, Vapor-Retarding Air Barrier Synthetic Polymer Type: Synthetic polymer membrane with an installed dry film thickness, according to manufacturer's written instructions, of 35 mils or thicker over smooth, void-free substrates.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Carlisle Coatings & Waterproofing Inc.
      - 1) Basis of Design: Barriseal
- B. Vapor Permeance: Maximum 0.02 perm; ASTM E96/E96M, Procedure A, Desiccant Method.

## 2.3 ACCESSORY MATERIALS

- A. Requirement: Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.



### PART 3 - EXECUTION

#### 3.1 SURFACE PREPARATION

- A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate in accordance with manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.
- B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- C. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching material.
- D. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- E. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.
- F. Bridge discontinuous wall-to-wall and deck-to-wall joints with air-barrier accessory material that accommodates joint movement in accordance with manufacturer's written instructions and details.

### 3.2 INSTALLATION

- A. Install materials in accordance with air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.
  - 1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
  - 2. Install transition strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over each substrate.
  - 3. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
  - 4. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
- B. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, other construction used in exterior wall openings, using accessory materials.
- C. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.
- D. High-Build Air Barriers: Apply continuous unbroken air-barrier material to substrates according to the following thickness. Apply air-barrier material in full contact around protrusions.
  - 1. Vapor-Retarding, High-Build Air Barrier: Total dry film thickness as recommended in writing by manufacturer to comply with performance requirements, but not less than 40 mils, applied in one coat.
- E. Do not cover air barrier until it has been tested and inspected by testing agency.
- F. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

### 3.3 CLEANING AND PROTECTION

- A. Protect air-barrier system from damage during application and remainder of construction period, in accordance with manufacturer's written instructions.
- B. Remove masking materials after installation.

END OF SECTION 072726

## SECTION 074213.19 - INSULATED METAL WALL PANELS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Foamed-insulation-core metal wall panels.

#### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details. Include the layout of Miscellaneous Metal Subframing and Furring as determined by panel manufacturer to be required for proper and secure installation of wall panels.
- C. Samples: For each type of metal panel indicated.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Warranties: Samples of special warranties.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

## 1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Finish Warranty Period: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing in accordance with ASTM E72:
  - 1. Wind Loads: As indicated on Drawings. See Sht S-001
  - 2. Other Design Loads: As indicated on Drawings. See Sht S-001
    - a. Project Seismic Risk Category: IV
    - b. Project Seismic Design Category: C
    - c. Project Seismic Importance Factor: 1.5

3. Deflection Limits: For wind loads, no greater than 1/240 of the span.
- B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested in accordance with ASTM E283 at the following test-pressure difference:
  1. Test-Pressure Difference: 6.24 lbf/sq. ft..
- C. Water Penetration under Static Pressure: No water penetration when tested in accordance with ASTM E331 at the following test-pressure difference:
  1. Test-Pressure Difference: 6.24 lbf/sq. ft..
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- E. Fire-Test-Response Characteristics: Provide metal wall panels and system components that comply with the requirements of the 2020 Building Code of NYS..

## 2.2 FOAMED-INSULATION-CORE METAL WALL PANELS

- A. General: Provide factory-formed and -assembled metal wall panels fabricated from two metal facing sheets and insulation core foamed in place during fabrication, and with joints between panels designed to form weathertight seals. Include accessories required for weathertight installation.

1. Insulation Core: Modified isocyanurate or polyurethane foam using a non-CFC blowing agent, with maximum flame-spread and smoke-developed indexes of 25 and 450, respectively.
  - a. Closed-Cell Content: 90 percent when tested in accordance with ASTM D6226.
  - b. Density: 2.0 to 2.6 lb/cu. ft. when tested in accordance with ASTM D1622.
  - c. Compressive Strength: Minimum 20 psi when tested in accordance with ASTM D1621.
  - d. Shear Strength: 26 psi when tested in accordance with ASTM C273/C273M.
- B. Concealed-Fastener, Foamed-Insulation-Core Metal Wall Panels: Formed with tongue-and-groove panel edges; designed for sequential installation by interlocking panel edges and mechanically attaching panels to supports using concealed clips or fasteners.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CENTRIA, a Nucor Brand.
    - b. Kingspan Insulated Panels, Inc.
    - c. MBCI; Cornerstone Building Brands.
    - d. Metl-Span; a Nucor Brand.
  2. Panel Types:
    - a. Panel Type 1:
      - 1) Exterior Face: Flat
      - 2) Installation Orientation: Vertical
      - 3) Color: Color 1 to be selected from manufacturer's full standard range.
      - 4) Basis of Design: Kingspan KS Azteco, or Metl-Span CF Architectural
    - b. Panel Type 2:
      - 1) Exterior Face: Flat
      - 2) Installation Orientation: Vertical
      - 3) Color: Color 2 to be selected from manufacturer's full standard range.
      - 4) Basis of Design: Kingspan KS Azteco, or Metl-Span CF Architectural
    - c. Panel Type 3:
      - 1) Exterior Face: Ribbed
      - 2) Installation Orientation: Horizontal
      - 3) Color: Color 3 to be selected from manufacturer's full standard range.
      - 4) Basis of Design: Kingspan KS Vale, or Metl-Span CF 7.2 Insul-Rib
  3. Metallic-Coated Steel Sheet: Facings of zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
    - a. Nominal Thickness: 0.034 inch (24 ga.).
    - b. Exterior Finish: Three-coat fluoropolymer.

- 1) Color: As selected by Architect from manufacturer's full range.
  - a) Three colors to be selected, one for each panel type
- c. Interior Finish: Siliconized polyester, or manufacturer's standard for non-exposed surface.
  - 1) Color: As selected by Architect from manufacturer's full range.
4. Panel Coverage: 36 inches nominal.
5. Panel Thickness: 3.0 inches.
6. Thermal-Resistance Value (R-Value): Measured in accordance with ASTM C1363:
  - a. Panel Types 1 and 2: Min R8 per inch @75 deg.
  - b. Panel Type 3: Min R16 @75 deg.

## 2.3 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 coating designation or ASTM A792/A792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
  1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
  2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
  3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are

not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

- D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- E. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
  - 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing; 1/2 inch wide and 1/8 inch thick.
  - 2. Joint Sealant: ASTM C920; as recommended in writing by metal panel manufacturer.
  - 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

## 2.4 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- C. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

## 2.5 FINISHES

- A. Panels and Accessories:
  - 1. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat,



- and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
- 2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages in accordance with ASTM C754 and metal panel manufacturer's written recommendations.

#### 3.2 INSTALLATION OF INSULATION-CORE METAL WALL PANELS

- A. General: Apply continuous ribbon of sealant to panel joint on concealed side of insulated metal wall panels as vapor seal; apply sealant to panel joint on exposed side of panels for weather seal.
  - 1. Fasten foamed-insulation-core metal wall panels to supports with fasteners at each lapped joint at location and spacing and with fasteners recommended by manufacturer.
  - 2. Apply panels and associated items true to line for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
  - 3. Provide metal-backed washers under heads of exposed fasteners on weather side of insulated metal wall panels.
  - 4. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
  - 5. Provide sealant tape at lapped joints of insulated metal wall panels and between panels and protruding equipment, vents, and accessories.
  - 6. Apply a continuous ribbon of sealant tape to panel side laps and elsewhere as needed to make panels weathertight.
  - 7. Apply snap-on battens to exposed-fastener, insulated-core metal wall panel seams to conceal fasteners.
- B. Foamed-Insulation-Core Metal Wall Panels: Fasten metal wall panels to supports with concealed clips at each joint at location and spacing and with fasteners recommended by manufacturer. Fully engage tongue and groove of adjacent panels.
  - 1. Install clips to supports with self-tapping fasteners.

- C. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
- D. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level. Install work with laps, joints, and seams that are permanently watertight.

### 3.3 CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

END OF SECTION 074213.19

## SECTION 075323 - ETHYLENE-PROPYLENE-DIENE-MONOMER (EPDM) ROOFING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Adhered ethylene-propylene-diene-terpolymer (EPDM) roofing system.
2. Accessory roofing materials.
3. Roof insulation.
4. Insulation accessories and cover board.

#### 1.2 PREINSTALLATION MEETINGS

- A. Preliminary Conference: Conduct conference at Project site.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness if insulation.
2. Base flashings and membrane terminations.
3. Flashing details at penetrations.
4. Tapered insulation, thickness, and slopes.
5. Roof plan showing orientation of steel roof deck and orientation of roof membrane and fastening spacings and patterns for mechanically fastened roofing system.
6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
7. Tie-in with air barrier.

- C. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

#### 1.4 INFORMATIONAL SUBMITTALS

##### A. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
  - a. Submit evidence of complying with performance requirements.
2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

- B. Product Test Reports: For components of roof membrane and insulation, for tests performed by a qualified testing agency, indicating compliance with specified requirements.

- C. Research reports.

- D. Field quality-control reports.

- E. Sample warranties.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

- B. Certified statement from existing roof membrane manufacturer stating that existing roof warranty has not been affected by Work performed under this Section.

#### 1.6 QUALITY ASSURANCE

##### A. Qualifications:

1. Installers: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 20 years from Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accelerated Weathering: Roof membrane to withstand 2000 hours of exposure when tested in accordance with ASTM G152, ASTM G154, or ASTM G155.
- B. Impact Resistance: Roof membrane to resist impact damage when tested in accordance with ASTM D3746, ASTM D4272, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.
- C. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures when tested in accordance with FM Approvals 4474, UL 580, or UL 1897:
  - 1. Wind Loads: See wind load design criteria on Structural drawings, Sheet S-000.

- D. Energy Star Listing: Roofing system to be listed on the DOE's Energy Star "Roof Products Qualified Product List" for low-slope roof products.
- E. Energy Performance: Roofing system to have an initial solar reflectance of not less than 0.70 and an emissivity of not less than 0.75 when tested in accordance with ANSI/CRRC S100.
- F. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

## 2.2 ETHYLENE-PROPYLENE-DIENE-TERPOLYMER (EPDM) ROOFING

- A. EPDM Sheet: ASTM D4637/D4637M, Type II, scrim or fabric internally reinforced, EPDM sheet.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Carlisle Syntec Systems.
    - b. Firestone Building Products.
    - c. GenFlex Roofing Systems.
    - d. Johns Manville; a Berkshire Hathaway company.
  - 2. Thickness: 60 mils, nominal.
  - 3. Exposed Face Color: White.

## 2.3 ACCESSORY ROOFING MATERIALS

- A. General: Accessory materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.
  - 1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.
- B. Sheet Flashing: 60-mil-thick EPDM, partially cured or cured, according to application.
  - 1. Provide white flashing accessories for white EPDM membrane roofing.
- C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.
- D. Bonding Adhesive: Manufacturer's standard.
- E. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.
- F. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening components to substrate, and acceptable to roofing system manufacturer.
- G. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, molded pipe boot flashings, preformed inside and outside corner sheet flashings, reinforced EPDM securement strips, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.
  - 1. Provide white flashing accessories for white EPDM membrane roofing.

## 2.4 ROOF INSULATION

- A. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 2 coated glass-fiber facer on both major surfaces.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Hunter Panels
    - b. GenFlex
    - c. Johns Manville
    - d. Atlas AC Foam
  - 2. Thermal Resistance: R-value of 6.0 per 1 inch, aged R-value 5.7 per inch
  - 3. Size: 48 by 96 inches.
  - 4. Thickness:
    - a. Two (2), 2 inch thick layers plus tapered insulation layer providing U-factor area averaging equivalent performance of R-30.
- B. Tapered Insulation: Provide factory-tapered insulation boards.
  - 1. Material: Match roof insulation.
  - 2. Minimum Thickness: 1/4 inch.
  - 3. Slope:
    - a. Saddles and Crickets: 1/4 inch per foot unless otherwise indicated on Drawings.



## 2.5 INSULATION ACCESSORIES AND COVER BOARD

- A. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.
- B. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer.
- A. Glass-Mat Gypsum Cover Board: ASTM C1177/C1177M, water-resistant gypsum board or ASTM C 1278/C 1278M fiber-reinforced gypsum board.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Certainteed; SAINT-GOBAIN.
    - b. Georgia-Pacific Gypsum LLC.
    - c. Gold Bond Building Products, LLC provided by National Gypsum Company.
    - d. USG Corporation.
  - 2. Thickness: 5/8 inch.
  - 3. Surface Finish: per roof manufacturer's recommendation.
- B. Protection Mat: Woven or nonwoven polypropylene, polyolefin, or polyester fabric; water permeable and resistant to UV degradation; type and weight as recommended by roofing system manufacturer for application.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

### 3.2 PREPARATION

- A. Perform fastener-pullout tests in accordance with roof system manufacturer's written instructions.
  - 1. Submit test result within 24 hours of performing tests.
    - a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.

### 3.3 INSTALLATION OF ROOFING, GENERAL

- A. Install roofing system in accordance with roofing system manufacturer's written instructions, assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.
- B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

### 3.4 INSTALLATION OF INSULATION

- A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.
- B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.
- C. Installation Over Metal Decking:
  - 1. Install base layer of insulation with joints staggered not less than 24 inches in adjacent rows.
    - a. Locate end joints over crests of decking.

- b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
  - c. Make joints between adjacent insulation boards not more than 1/4 inch in width.
  - d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.
    - 1) Trim insulation so that water flow is unrestricted.
  - e. Fill gaps exceeding 1/4 inch with insulation.
  - f. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
  - g. Loosely lay base layer of insulation units over substrate.
  - h. Mechanically attach base layer of insulation using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.
    - 1) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.
2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches from previous layer of insulation.
- a. Staggered end joints within each layer not less than 24 inches in adjacent rows.
  - b. Install with long joints continuous and with end joints staggered not less than 12 inches in adjacent rows.
  - c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
  - d. Make joints between adjacent insulation boards not more than 1/4 inch in width.
  - e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.
  - f. Trim insulation so that water flow is unrestricted.
  - g. Fill gaps exceeding 1/4 inch with insulation.
  - h. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.

- i. Adhere each layer of insulation to substrate using adhesive in accordance with and FM Global Property Loss Prevention Data Sheet 1-29, as follows:
  - 1) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

### 3.5 INSTALLATION OF COVER BOARDS

- A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction.
  1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
  2. At internal roof drains, conform to slope of drain sump.
    - a. Trim cover board so that water flow is unrestricted.
  3. Cut and fit cover board tight to nailers, projections, and penetrations.
  4. Loosely lay cover board over substrate.
  5. Adhere cover board to substrate using adhesive in accordance FM Global Property Loss Prevention Data Sheet 1-29 as follows:
    - a. Set cover board in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

### 3.6 ADHERED ROOFING INSTALLATION

- A. Adhere roof membrane over area to receive roofing in accordance with roofing system manufacturer's written instructions.
- B. Unroll membrane roof membrane and allow to relax before installing.
- C. Start installation of roofing in presence of roofing system manufacturer's technical personnel.
- D. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- E. Bonding Adhesive: Apply to substrate and underside of roof membrane at rate required by manufacturer, and allow to partially dry before installing roof membrane. Do not apply to splice area of roof membrane.
- F. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeters.
- G. Apply roof membrane with side laps shingled with slope of roof deck where possible.
- H. Adhesive Seam Installation: Clean both faces of splice areas, apply splicing cement.
  - 1. Firmly roll side and end laps of overlapping roof membrane to ensure a watertight seam installation.
  - 2. Apply lap sealant and seal exposed edges of roofing terminations.
  - 3. Apply a continuous bead of in-seam sealant before closing splice if required by roofing system manufacturer.
- I. Spread sealant or mastic bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

### 3.7 INSTALLATION OF BASE FLASHING

- A. Install sheet flashings and preformed flashing accessories, and adhere to substrates in accordance with roofing system manufacturer's written instructions.

- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

### 3.8 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing system, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and in accordance with warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075323

## SECTION 077100 - ROOF SPECIALTIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes: Manufactured units for the following applications:

1. Copings.
2. Roof-edge specialties.

#### 1.2 ACTION SUBMITTALS

A. Product data.

B. Shop Drawings: For roof specialties.

1. Plans, expansion-joint locations, keyed details, and attachments to other work. Distinguish between factory pre manufactured- and field-assembled installation.
2. Details for expansion and contraction; locations of expansion joints, including direction of expansion and contraction.
3. Indicate profile and pattern of seams and layout of fasteners, cleats, clips, and other attachments.
4. Details of termination points and assemblies, including fixed points.
5. Details of special conditions.

C. Samples: For each type of roof specialty indicated with factory-applied color finishes.

#### 1.3 INFORMATIONAL SUBMITTALS

A. Product certificates.

- B. Product test reports.
- C. Sample warranty.

#### 1.4 WARRANTY

- A. Special Warranty on Painted Finishes: Manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
    - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Finish Warranty Period: 10 years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Roof specialties to withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.



- B. SPRI Wind Design Standard: Manufacture and install copings roof-edge specialties tested in accordance with ANSI/SPRI/FM 4435/ES-1 and capable of resisting the following design pressures:

1. Design Criteria: As indicated on Drawing S-001, wind speed 130 mph.

- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

## 2.2 COPINGS

- A. Metal Copings: Manufactured coping system consisting of metal coping cap in section lengths not exceeding 12 ft., concealed anchorage; with corner units, end cap units, and concealed splice plates with finish matching coping caps.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- a. ATAS International, Inc.
- b. Berridge Manufacturing Company.
- c. Englert, Inc.
- d. Hickman; an MTL Company.
- e. Metal-Era, Inc.

2. Metallic-Coated Steel Coping Caps: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, nominal 0.034-inch thickness.

- a. Surface: Smooth, flat finish.
  - b. Finish: Two-coat fluoropolymer.
  - c. Color: As selected by Architect from manufacturer's full range.
3. Corners: Factory mitered and soldered.
4. Coping-Cap Attachment Method: Snap-on or face leg hooked to continuous cleat with back leg fastener exposed, fabricated from coping-cap material.
  - a. Snap-on Coping Anchor Plates: Concealed, galvanized-steel sheet, 12 inches wide, with integral cleats.
  - b. Face-Leg Cleats: Concealed, continuous galvanized-steel sheet.

## 2.3 ROOF-EDGE SPECIALTIES

- A. Roof-Edge Fascia: Manufactured, two-piece, roof-edge fascia consisting of snap-on metal fascia cover in section lengths not exceeding 12 ft. and a continuous metal receiver with integral drip-edge cleat to engage fascia cover[ **and secure single-ply roof membrane**]. Provide matching corner units.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. ATAS International, Inc.
    - b. Berridge Manufacturing Company.
    - c. Englert, Inc.
    - d. Hickman; an MTL Company.
    - e. Metal-Era, Inc.
  2. Metallic-Coated Steel Fascia Covers: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, nominal 0.034-inch thickness.
    - a. Surface: Smooth, flat finish.
    - b. Finish: Two-coat fluoropolymer.
    - c. Color: As selected by Architect from manufacturer's full range.
  3. Corners: Factory mitered and soldered.
  4. Splice Plates: Concealed, of same material, finish, and shape as fascia cover.
  5. Receiver: Galvanized-steel sheet, nominal 0.040-inch thickness.

## 2.4 SHEET METAL MATERIALS

- A. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with minimum ASTM A653/A653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with minimum ASTM A792/A792M, Class AZ50 coating designation; structural quality..
  1. Exposed Coil-Coated Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

- a. Two-Coat Fluoropolymer Finish: AAMA 2605. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight in color coat.
2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.

## 2.5 MISCELLANEOUS MATERIALS

- A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.
- B. Fasteners: Roof specialty manufacturer's recommended fasteners, designed to meet performance requirements, suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:
  1. Fasteners for Metallic-Coated Steel Sheet: Series 300 stainless steel or hot-dip zinc-coated steel in accordance with ASTM A153/A153M or ASTM F2329/F2329M.
  2. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
- C. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.
- D. Elastomeric Sealant: ASTM C920, elastomeric silicone polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.
- E. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type joints with limited movement.
- F. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- G. Asphalt Roofing Cement: ASTM D4586, asbestos free, of consistency required for application.

## 2.6 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.
- B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Install roof specialties in accordance with manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, protective coatings, separators, underlayments, sealants, and other miscellaneous items as required to complete roof-specialty systems.
  - 1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
  - 2. Provide uniform, neat seams with minimum exposure of solder and sealant.
  - 3. Install roof specialties to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
  - 4. Torch cutting of roof specialties is not permitted.
  - 5. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer's written installation instructions.
  - 1. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.
- C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.
  - 1. Space movement joints at a maximum of 12 ft. with no joints within 18 inches of corners or intersections unless otherwise indicated on Drawings.
  - 2. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.
- D. Fastener Sizes: Use fasteners of sizes that penetrate substrate not less than recommended in writing by fastener manufacturer to achieve maximum pull-out resistance.

- E. Seal concealed joints with butyl sealant as required by roof specialty manufacturer.
- F. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F.

### 3.2 INSTALLATION OF COPINGS

- A. Install cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.
- B. Anchor copings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.
  - 1. Interlock face and back leg drip edges of snap-on coping cap into cleated anchor plates anchored to substrate at manufacturer's required spacing that meets performance requirements.
  - 2. Interlock face-leg drip edge into continuous cleat anchored to substrate at manufacturer's required spacing that meets performance requirements. Anchor back leg of coping with screw fasteners and elastomeric washers at manufacturer's required spacing that meets performance requirements.

### 3.3 INSTALLATION OF ROOF-EDGE SPECIALTIES

- A. Install cleats, cants, and other anchoring and attachment accessories and devices with concealed fasteners.
- B. Anchor roof edgings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

### 3.4 CLEANING AND PROTECTION

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing in accordance with ASTM A780/A780M.
- B. Remove temporary protective coverings and strippable films as roof specialties are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain roof specialties in a clean condition during construction.

- C. Replace roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION 077100

## SECTION 077200 - ROOF ACCESSORIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes: Manufactured units for the following applications:
  - 1. Roof hatches.

#### 1.2 ACTION SUBMITTALS

- A. Product data.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Roof accessories to withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

## 2.2 ROOF HATCHES

- A. Metal roof-hatch units with lids and insulated double-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, straight sides, and integrally formed deck-mounting flange at perimeter bottom.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Babcock-Davis.
  - 2. JL Industries; Activar Construction Products Group, Inc.
  - 3. Milcor by Duravent; Duravent Group.
  - 4. Nystrom, Inc.
- C. Type and Size:
  - 1. Single-leaf lid, 36 by 36 inches.
- D. Loads: Minimum 40 lbf/sq. ft. external live load and 20 lbf/sq. ft. internal uplift load.
- E. Hatch Material, Steel: Zinc-coated (galvanized) steel sheet.
  - 1. Thickness: Manufacturer's standard thickness for hatch size indicated.
  - 2. Finish: Powder coat.
  - 3. Color: As selected by Architect from manufacturer's full range.
- F. Construction:
  - 1. Insulation: 2-inch-thick, polyisocyanurate board.



- a. R-Value: 4.3 in accordance with ASTM C1363.
  - 2. Nailer: Factory-installed wood nailer continuous around hatch perimeter.
  - 3. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
  - 4. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
  - 5. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
  - 6. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.
- G. Hardware: Spring operators, hold-open arm, galvanized steel spring latch with turn handles, galvanized steel butt- or pintle-type hinge system, and padlock hasps inside and outside.
- H. Ladder-Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder.
- 1. Operation: Post locks in place on full extension; release mechanism returns post to closed position.
  - 2. Height: 42 inches above finished roof deck.
  - 3. Material: Steel tube.

4. Post: 1-5/8-inch- diameter pipe.
5. Finish: Manufacturer's standard.
  - a. Color: As selected by Architect from manufacturer's full range.

## 2.3 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA AMP 500, "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Install roof accessories in accordance with manufacturer's written instructions.
  1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
  2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
  3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
  4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

### 3.2 INSTALLATION OF ROOF ACCESSORIES

- A. Roof-Hatch:
  1. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
  2. Attach ladder-assist post in accordance with manufacturer's written instructions.

### 3.3 CLEANING AND PROTECTION

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing in accordance with ASTM A780/A780M.

- B. Touch up factory-primed surfaces with compatible primer ready for field painting in accordance with Section 099113 "Exterior Painting."
- C. On completion of installation, clean exposed surfaces in according with manufacturer's written instructions. Clean off excess sealants.
- D. Remove temporary protective coverings and strippable films as roof accessories are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain roof accessories in a clean condition during construction.
- E. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION 077200

## SECTION 078413 - PENETRATION FIRESTOPPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Penetration firestopping systems.
2. Penetrations in fire-resistance-rated walls.
3. Penetrations in horizontal assemblies.
4. Exposed penetration firestopping systems.

#### 1.2 ACTION SUBMITTALS

A. Product data.

B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly developed in accordance with current International Firestop Council (IFC) guidelines. Obtain approval of authorities having jurisdiction prior to submittal.

#### 1.3 INFORMATIONAL SUBMITTALS

A. Listed system designs.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Entity that has been approved by FM Approvals in accordance with FM Approvals 4991 or been evaluated by UL and found to comply with UL's "UL Solutions Qualified Firestop Contractor Program."
- B. Manufacturer Qualifications: Entity that has received UL's "Firestop Movement Certification," which demonstrates that manufacturer's firestopping products designated with M-Ratings are based on exposure to cyclic movement and UL 1479 fire test evaluation when tested in accordance with ASTM E3037.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
  - 1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
  - 2. Test in accordance with testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:

- a. Penetration firestop systems installed with products bearing the classification marking of a qualified testing agency.

- 1) UL in its online directory "Product iQ."
- 2) FM Approvals in its "Approval Guide."

## 2.2 PENETRATION FIRESTOPPING SYSTEMS

- A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems are to be compatible with one another, with the substrates forming openings, and with penetrating items if any.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. 3M Building and Construction.
    - b. FireShield; Fire Rated Solutions LLC.
    - c. Hilti, Inc.
    - d. Tremco Incorporated.
- B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined in accordance with ASTM E814 or UL 1479.
  1. F-Rating: Not less than the fire-resistance rating of the wall penetrated.
- C. Penetrations in Horizontal Assemblies: Horizontal assemblies in this project do not carry a fire rating, but penetrations shall be sealed with firestopping material to prevent the penetration of smoke and products of combustion.
- D. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested in accordance with ASTM E84 or UL 723.
- E. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION OF PENETRATION FIRESTOPPING SYSTEMS

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.
- C. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.
  - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
- D. Install fill materials by proven techniques to produce the following results:
  - 1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
  - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
  - 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

#### 3.2 IDENTIFICATION

- A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.
  - 1. Locate in ceiling cavity space at 15 ft. from end of wall and at intervals not exceeding 30 ft..

#### 3.3 FIELD QUALITY CONTROL

- A. Owner will engage a qualified inspection agency to conduct and report on inspections in accordance with ASTM E2174.
- B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.
- C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

END OF SECTION 078413



## SECTION 079200 - JOINT SEALANTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Non-staining silicone joint sealants.
  - 2. Urethane joint sealants.
  - 3. Mildew-resistant joint sealants.
  - 4. Butyl joint sealants.
  - 5. Latex joint sealants.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. Samples: For each kind and color of joint sealant required.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Sample warranties.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C1021 to conduct the testing indicated.

1.5 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
  - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
  - 2. When joint substrates are wet.
  - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
  - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.6 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
  - 1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
  - 2. Disintegration of joint substrates from causes exceeding design specifications.
  - 3. Mechanical damage caused by individuals, tools, or other outside agents.
  - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

## PART 2 - PRODUCTS

### 2.1 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

### 2.2 NON-STAINING SILICONE JOINT SEALANTS

- A. Non-staining Joint Sealants: No staining of substrates when tested according to ASTM C1248.
- B. Silicone, Non-staining, S, NS, 50, NT: Non-staining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Pecora Corporation.
    - b. Sika Corporation; Joint Sealants.
    - c. Tremco Incorporated.

### 2.3 URETHANE JOINT SEALANTS

- A. Urethane, M, P, 25, T, NT: Multicomponent, pourable, plus 25 percent and minus 25 Urethane, M, P, 25, T, NT: Multicomponent, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade P, Class 25, Uses T and NT.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Pecora Corporation.
    - b. Sika Corporation; Joint Sealants.
    - c. Tremco Incorporated.

## 2.4 MILDEW-RESISTANT JOINT SEALANTS

- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
- B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. GE Construction Sealants; Momentive Performance Materials Inc.
    - b. Pecora Corporation.
    - c. Tremco Incorporated.

## 2.5 BUTYL JOINT SEALANTS

- A. Butyl-Rubber-Based Joint Sealants: ASTM C1311.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Bostik, Inc.
    - b. Pecora Corporation.

2.6 Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. May National Associates, Inc.; a subsidiary of Sika Corporation.
  - b. Pecora Corporation.
  - c. Tremco Incorporated.

2.7 JOINT-SEALANT BACKING

- A. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin), Type O (open-cell material), Type B (bicellular material with a surface skin), or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Alcot Plastics Ltd.
    - b. BASF Corporation.
    - c. Construction Foam Products; a division of Nomaco, Inc.
- B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

2.8 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.
- C. Masking Tape: Non-staining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
  - 1. Remove laitance and form-release agents from concrete.
  - 2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces.

#### 3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with ASTM C1193 and joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
- C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
  - 1. Place sealants so they directly contact and fully wet joint substrates.
  - 2. Completely fill recesses in each joint configuration.
  - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

- E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.

- 1. Provide concave joint profile per Figure 8A in ASTM C1193 unless otherwise indicated.

### 3.4 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

- 1. Extent of Testing: Test completed and cured sealant joints as follows:
    - a. Perform 5 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
    - b. Perform one test for each 1000 feet of joint length thereafter or one test per each floor per elevation.
  - 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.

- B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

### 3.5 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

### 3.6 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

### 3.7 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.
  - 1. Joint Locations:
    - a. Isolation and contraction joints in cast-in-place concrete slabs.
  - 2. Joint Sealant: Urethane, M, P, 25, T, NT.
  - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Joint-Sealant Application: Exterior joints in vertical surfaces.
  - 1. Joint Locations:
    - a. Exterior perimeter joints between building components
    - b. Other joints as indicated on Drawings.
  - 2. Joint Sealant: Silicone, non-staining, S, NS, 50, NT.
  - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.



- C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
  - 1. Joint Locations:
    - a. Isolation joints in cast-in-place concrete slabs.
  - 2. Joint Sealant: Urethane, Urethane, M, P, 25, T, NT .
  - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
  - 1. Joint Locations:
    - a. Control and expansion joints on exposed interior surfaces of exterior walls.
    - b. Vertical joints on exposed surfaces of unit masonry.
  - 2. Joint Sealant: Silicone, non-staining, S, NS, 50, NT.
  - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- E. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.
  - 1. Joint Locations:
    - a. Control joints on exposed interior surfaces of exterior walls.
    - b. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
    - c. Other joints as indicated on Drawings.
  - 2. Joint Sealant: Acrylic latex.
  - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- F. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
  - 1. Joint Locations:
    - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
    - b. Tile control and expansion joints where indicated.
    - c. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

G. Joint-Sealant Application: Concealed mastics.

1. Joint Locations:
  - a. Aluminum thresholds.
  - b. Sill plates.
  - c. Other joints as indicated on Drawings.
2. Joint Sealant: Butyl-rubber based.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 079200

## SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes:
  - 1. Interior standard steel doors, frames and sidelights.
  - 2. Exterior standard steel doors and frames.
- B. Related Requirements:
  - 1. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.

#### 1.3 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include the following:
  - 1. Elevations of each door and sidelight type.
  - 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
  - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
- C. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.6 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Field quality control reports.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
  - 1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch- high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Ceco Door; ASSA ABLOY.
  2. Republic Doors and Frames.
  3. Steelcraft; an Allegion brand.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.

### 2.3 INTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Extra-Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 3; ANSI/SDI A250.4, Level A.
1. Doors:
    - a. Type: As indicated in the Door and Frame Schedule.
    - b. Thickness: 1-3/4 inches.
    - c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch.
    - d. Edge Construction: Model 1, Full Flush.
    - e. Core: Kraft-paper honeycomb.
  2. Frames:
    - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch.
    - b. Construction: Full profile welded.

### 2.4 EXTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Extra-Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 3; ANSI/SDI A250.4, Level A..
  - 1. Doors:
    - a. Type: As indicated in the Door and Frame Schedule.
    - b. Thickness: 1-3/4 inches.
    - c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A60 coating.
    - d. Edge Construction: Model 1, Full Flush.
    - e. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
    - f. Bottom Edges: Close bottom edges of doors with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
    - g. Core: Polyurethane.
  - 2. Frames:
    - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A60 coating.

- b. Construction: Full profile welded in masonry construction
- c. Construction: Knock down in metal framed partitions

## 2.5 FRAME ANCHORS

### A. Jamb Anchors:

- 1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
- 2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 feet.

### B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.

### C. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

- 1. 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.

## 2.6 MATERIALS

### A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

### B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

### C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.

### D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A153M.

- E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- F. Glazing: Comply with requirements in Section 088000 "Glazing."

## 2.7 FABRICATION

- A. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
  - 1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
  - 2. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
    - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- B. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to ANSI/SDI A250.6, the Door Hardware Schedule, and templates.
  - 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
  - 2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.
- C. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
  - 1. Provide stops and moldings flush with face of door, and with beveled stops unless otherwise indicated.
  - 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
  - 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.
  - 4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
  - 5. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.



## 2.8 STEEL FINISHES

### A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

### 3.2 INSTALLATION

#### A. Hollow-Metal Frames: 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 without damage to completed Work.
2. Floor Anchors: Secure with postinstalled expansion anchors.
  - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.

4. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
  - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
  - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
  - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
  - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- B. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
  1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8.
  2. Fire-Rated Doors: Install doors with clearances in accordance with NFPA 80.
- C. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

### 3.3 FIELD QUALITY CONTROL

- A. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- B. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.4 REPAIR

- A. 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.
- B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 081113

## SECTION 081416 - FLUSH WOOD DOORS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Five-ply flush wood veneer-faced doors for transparent finish.
2. Factory finishing flush wood doors.
3. Factory fitting flush wood doors to frames and factory machining for hardware.

B. Related Requirements:

1. Section 088000 "Glazing" for glass view panels in flush wood doors.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Door core materials and construction.
2. Door edge construction
3. Door face type and characteristics.
4. Factory-finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:

1. Door schedule indicating door location, type, size, fire protection rating, and swing.

2. Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.
3. Dimensions and locations of blocking for hardware attachment.
4. Clearances and undercuts.
5. Requirements for veneer matching.

C. Samples: For factory-finished doors.

### 1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

### 1.4 CLOSEOUT SUBMITTALS

A. Special warranties.

### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in plastic bags or cardboard cartons.
- C. Mark each door on bottom rail with opening number used on Shop Drawings.

### 1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of construction period.

### 1.7 WARRANTY

- A. Special Warranty: In accordance with their Limited Lifetime Warranty, the Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
  1. Failures include, but are not limited to, the following:
    - a. Delamination of veneer.
    - b. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
    - c. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
  2. Warranty Period for Solid-Core Interior Doors: Life of installation.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Wood Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated on Drawings.

### 2.2 FLUSH WOOD DOORS, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with ANSI/WDMA I.S. 1A.
  - 1. Provide labels from AWI certification program indicating that doors comply with requirements of grades specified.
- B. Adhesives: Do not use adhesives that contain urea formaldehyde.
- C. Composite Wood Products: Verify products are made without added urea formaldehyde.

### 2.3 SOLID-CORE, FIVE-PLY FLUSH WOOD VENEER-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Doors:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Eggers Industries.
  - b. Lambton Doors.
  - c. Masonite Architectural.
  - d. Oshkosh Door Company.
  - e. VT Industries Inc.
2. Performance Grade: ANSI/WDMA I.S. 1A Extra Heavy Duty.
3. ANSI/WDMA I.S. 1A Grade: Custom.
4. Faces: Single-plywood veneer not less than 1/50 inch thick.
  - a. Species: Select white birch.
  - b. Cut: Plain sliced (flat sliced).
  - c. Match between Veneer Leaves: Book match.
  - d. Assembly of Veneer Leaves on Door Faces: Running match.
  - e. Room Match: Provide door faces of compatible color and grain within each separate room or area of building.
5. Exposed Vertical Edges: Applied wood-veneer edges of same species as faces and covering edges of faces - Architectural Woodwork Standards edge Type B.

6. Core for Non-Fire-Rated Doors:
  - a. ANSI A208.1, Grade LD-2 particleboard.
    - 1) Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
7. Core for Fire-Rated Doors: As required to achieve fire-protection rating indicated on Drawings.
  - a. Blocking for Mineral-Core Doors: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated on Drawings as needed to eliminate through-bolting hardware.
8. Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.
9. Security Rating: Class 40.

#### 2.4 LIGHT FRAMES

- A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.
  1. Wood Species: Species compatible with door faces.
  2. Profile: Manufacturer's standard shape.



## 2.5 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated.
  - 1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
- B. Factory machine doors for hardware that is not surface applied.
  - 1. Locate hardware to comply with DHI-WDHS-3.
  - 2. Comply with final hardware schedules, door frame Shop Drawings, ANSI/BHMA-156.115-W, and hardware templates.
  - 3. Coordinate with hardware mortises in metal frames, to verify dimensions and alignment before factory machining.
- C. Openings: Factory cut and trim openings through doors.
  - 1. Light Openings: Trim openings with moldings of material and profile indicated.
  - 2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."

## 2.6 FACTORY FINISHING

- A. Comply with referenced quality standard for factory finishing.

1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
  2. Finish faces, all four edges, edges of cutouts, and mortises.
- B. Factory finish doors.
- C. Transparent Finish:
1. ANSI/WDMA I.S. 1A Grade: Custom.
  2. Finish: ANSI/WDMA I.S. 1A TR-8 UV Cured Acrylated Polyester/Urethane
  3. Staining: As selected by Architect from Manufacturer's full standard range
  4. Sheen: Satin.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine doors and installed door frames, with Installer present, before hanging doors.
1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
  2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Hardware: For installation, see Section 087111 "Door Hardware (Descriptive Specification)."
- B. Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
1. Install fire-rated doors in accordance with NFPA 80.

C. Job-Fitted Doors:

1. Align and fit doors in frames with uniform clearances and bevels as indicated below.
  - a. Do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors.
2. Machine doors for hardware.
3. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
4. Clearances:
  - a. Provide 1/8 inch at heads, jambs, and between pairs of doors.
5. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.
6. Bevel fire-rated doors 1/8 inch in 2 inches at lock edge; trim stiles and rails only to extent permitted by labeling agency

- D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 FIELD QUALITY CONTROL

- A. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- B. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.4 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

## SECTION 083313 - COILING COUNTER DOORS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Counter door assemblies.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type and size of coiling counter door and accessory.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

1. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
2. Show locations of locking devices, and other accessories.

C. Samples: For each exposed product and for each color and texture specified.

#### 1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

### PART 2 - PRODUCTS

2.1 COUNTER DOOR ASSEMBLY

- A. Counter Door: Coiling counter door formed with curtain of interlocking metal slats.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Clopay Building Products.
    - b. Cookson; a CornellCookson company.
    - c. Cornell; a CornellCookson company.
    - d. McKeon Door Company.
    - e. Wayne Dalton; a division of Overhead Door Corporation.
- B. Operation Cycles: Door components and operators capable of operating for not less than 50,000.
- C. Door Curtain Material: Galvanized steel.
- D. Door Curtain Slats: Flat profile slats of 1-1/2-inch center-to-center height.
- E. Bottom Bar: Manufacturer's standard continuous channel or tubular shape, fabricated hot-dip galvanized steel and finished to match door.
- F. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise.

- G. Hood: Galvanized steel.
  - 1. Mounting: In soffit.
- H. Sill Configuration: No sill.
- I. Locking Devices: Equip door with locking device assembly.
  - 1. Locking Device Assembly: Cremone-type, both jamb sides locking bars, operable from inside with thumbturn, outside with cylinder.
- J. Manual Door Operator: Push-up operation.
- K. Door Finish:
  - 1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.

## 2.2 DOOR CURTAIN MATERIALS AND FABRICATION

- A. Door Curtains: Fabricate coiling counter door curtain of interlocking metal slats in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
- B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain

curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

## 2.3 HOODS

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

## 2.4 LOCKING DEVICES

- A. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
  - 1. Lock Cylinders: As standard with manufacturer.
  - 2. Keys: Three for each cylinder.

## 2.5 CURTAIN ACCESSORIES

- A. Astragal: Equip each door bottom bar with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.
- B. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.



## 2.6 COUNTERBALANCE MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

## 2.7 MANUAL DOOR OPERATORS

- A. General: Equip door with manual door operator by door manufacturer.
- B. Push-up Door Operation: Design counterbalance mechanism so that required lift or pull for door operation does not exceed 25 lbf.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Install coiling counter doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

### 3.2 FIELD QUALITY CONTROL

- A. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- B. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.3 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain coiling counter doors.

END OF SECTION 083313

## SECTION 083323 - OVERHEAD COILING DOORS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Service doors.

#### 1.2 ACTION SUBMITTALS

##### A. Product Data: For each type and size of overhead coiling door and accessory.

##### B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

1. Show locations of controls, locking devices detectors or replaceable fusible links, and other accessories.
2. Include diagrams for power, signal, and control wiring.

#### 1.3 INFORMATIONAL SUBMITTALS

##### A. Sample warranty.

#### 1.4 CLOSEOUT SUBMITTALS

##### A. Special warranty.

##### B. Maintenance data.

#### 1.5 QUALITY ASSURANCE

##### A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

#### 1.6 WARRANTY

##### A. Special Warranty: Manufacturer agrees to repair or replace components of doors that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

### 2.2 DOOR ASSEMBLY <Insert drawing designation>

- A. Service Door: Overhead coiling door formed with curtain of interlocking metal slats.
  - 1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Operation Cycles: Door components and operators capable of operating for not less than [10,000] [20,000] [50,000] [100,000] [200,000] <Insert number>.
- C. Door Curtain Material: Galvanized steel.
- D. Door Curtain Slats: Flat profile slats of 2-5/8-inch center-to-center height.
- E. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch thick; fabricated from hot-dip galvanized steel and finished.
- F. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.
- G. Hood: Match curtain material and finish.
  - 1. Mounting: Face of wall.
- H. Electric Door Operator:
  - 1. Usage Classification: Medium duty, up to 12 cycles per hour and up to 50 cycles per day.
  - 2. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use.
  - 3. Motor Exposure: Interior.
  - 4. Motor Electrical Characteristics:
    - a. Horsepower: 1/2 hp.
    - b. Voltage: 115 V ac, single phase, 60 Hz.
  - 5. Emergency Manual Operation: Chain type.
  - 6. Obstruction-Detection Device: Automatic sensor electric sensor edge on bottom bar.
  - 7. Control Station(s): Interior mounted.
- I. Door Finish:
  - 1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.
  - 2. Factory Prime Finish: Manufacturer's standard color.
  - 3. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

## 2.3 MATERIALS, GENERAL

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## 2.4 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
- B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

## 2.5 HOODS

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

## 2.6 LOCKING DEVICES

- A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.

## 2.7 ELECTRIC DOOR OPERATORS

- A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
  - 1. Comply with NFPA 70.
  - 2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.
- B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.
- C. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated for each door assembly.

1. Electrical Characteristics: Minimum as indicated for each door assembly. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
  2. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
- D. Obstruction-Detection Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. For non-fire-rated doors, activation of device immediately stops and reverses downward door travel.
1. Electric Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
    - a. Self-Monitoring Type: Four-wire-configured device designed to interface with door operator control circuit to detect damage to or disconnection of sensor edge.
- E. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."
1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
- F. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation.
- G. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
- H. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION, GENERAL

- A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Power-Operated Doors: Install according to UL 325.

3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Test door release, closing, and alarm operations when activated by smoke detector or building's fire-alarm system. Test manual operation of closed door. Reset door-closing mechanism after successful test.
- B. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- C. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.3 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION 083323

## SECTION 083613 - SECTIONAL DOORS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Sectional-door assemblies.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type and size of sectional door and accessory.
- B. Shop Drawings: For each installation and for components not dimensioned or detailed in manufacturer's product data.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Sample warranties.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

#### 1.6 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of sectional doors that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Finish Warranty: Manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Warranty Period: 10 years from date of Substantial Completion.



## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Provide sectional doors that comply with performance requirements specified without failure from defective manufacture, fabrication, installation, or other defects in construction and without requiring temporary installation of reinforcing components.
- B. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.
  - 1. Design Wind Load: See Design Loads on Sht S-001. Project Design Wind Speed 130mph
  - 2. Testing: In accordance with ASTM E330/E330M.
- C. Seismic Performance: Provide sectional doors that withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.
  - 1. Component Importance Factor: 1.5.
  - 2. Risk Category: IV
  - 3. Seismic Design Category: C

### 2.2 SECTIONAL-DOOR ASSEMBLY

- A. Steel Sectional Door: Provide sectional door formed with hinged sections and fabricated so that finished door assembly is rigid and aligned with tight hairline joints; free of warp, twist, and deformation; and complies with requirements in DASMA 102.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Clopay Building Products.
    - b. Overhead Door Corporation.
    - c. Raynor Garage Doors.
    - d. Wayne Dalton; a division of Overhead Door Corporation.
  - 2. Basis of Design Model: Overhead Door Corporation Model 592
- B. Operation Cycles: Door components and operators capable of operating for not less than 100,000 operation cycles. One operation cycle is complete when door is opened from closed position to the open position and returned to closed position.
- C. Air Infiltration: Maximum rate of 0.13 cfm/sq. ft. at 25mph when tested in accordance with ASTM E283 or DASMA 105.
- D. U-Factor: 0.10 Btu/sq. ft. x h x deg F.
- E. R-Value: 17.5

- F. Steel Door Sections: ASTM A653/A653M, zinc-coated (galvanized), cold-rolled, commercial steel sheet.
1. Door-Section Thickness: 2 inches.
  2. Section Faces:
    - a. Thermal-Break Construction: Provide sections with continuous thermal-break construction separating the exterior and interior faces of door.
    - b. Exterior Face: Fabricated from single sheets, not more than 24 inches high; with horizontal meeting edges rolled to continuous, interlocking, keyed, rabbeted, shiplap, or tongue-in-groove, weather- and pinch-resistant seals and reinforcing flange return.
      - 1) Steel Sheet Thickness: 0.015-inch nominal coated thickness.
      - 2) Surface: Manufacturer's standard, ribbed.
    - c. Interior Face: Enclose insulation completely within steel exterior facing and interior facing material, with no exposed insulation. Provide the following interior-facing material:
      - 1) Zinc-Coated (Galvanized) Steel Sheet: With minimum nominal coated thickness of 0.015 inch.
  3. End Stiles: Enclose open ends of sections with channel end stiles formed from galvanized-steel sheet not less than 0.040-inch nominal coated thickness and welded to door section.
  4. Section Reinforcing: Horizontal and diagonal reinforcement as required to stiffen door and for wind loading. Provide galvanized-steel bars, struts, trusses, or strip steel, formed to depth and bolted or welded in place. Ensure that reinforcement does not obstruct vision lites.
    - a. Bottom Section: Reinforce section with a continuous channel or angle conforming to bottom-section profile and allowing installation of astragal (weatherseal).
    - b. Hardware Locations: Provide reinforcement for hardware attachment.
  5. Thermal Insulation: Insulate interior of steel sections with door manufacturer's standard insulation of type indicated below:
    - a. Foamed-in-Place Insulation: Polyurethane, foamed in place to completely fill interior of section and pressure bonded to face sheets to prevent delamination under wind load.
    - b. Fire-Resistance Characteristics: Maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, in accordance with ASTM E84.
- G. Track: Manufacturer's standard, galvanized-steel, standard lift clearance track system. Provide complete system including brackets, bracing, and reinforcement to ensure rigid support of ball-bearing roller guides.
1. Material: Galvanized steel, ASTM A653/A653M, minimum G60 zinc coating.
  2. Size: 2 inches wide.

3. Track Reinforcement and Supports: Provide galvanized-steel members to support track without sag, sway, and vibration during opening and closing of doors. Slot vertical sections of track spaced 2 inches apart for door-drop safety device.
  - a. Vertical Track: Incline vertical track to ensure weathertight closure at jambs. Provide intermittent jamb brackets attached to track and wall.
  - b. Horizontal Track: Provide continuous reinforcing angle from curve in track to end of track, attached to track and supported at points by laterally braced attachments to overhead structural members.
- H. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom top and jambs of door.
- I. Windows: Manufacturer's standard window units of shape and size and in locations indicated on Drawings. Set glazing in vinyl, rubber, or neoprene glazing channel. Provide removable stops of same material as door-section frames. Provide the following glazing:
  1. Clear Polycarbonate Plastic: 3 mm thick, transparent, fire-retardant, UV-resistant, polycarbonate sheet manufactured by extrusion process.
- J. Hardware: Heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless steel, or other corrosion-resistant fasteners, to suit door type.
  1. Hinges: Heavy-duty, galvanized-steel hinges of not less than 0.079-inch nominal coated thickness at each end stile and at each intermediate stile, in accordance with manufacturer's written recommendations for door size.
    - a. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is impossible.
  2. Rollers: Heavy-duty rollers with steel ball bearings in case-hardened steel races, mounted to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Match roller-tire diameter to track width.
    - a. Roller-Tire Material: Case-hardened steel.
- K. Locking Device:
  1. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on single-jamb side, operable from inside only.
  2. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.
- L. Counterbalance Mechanism:
  1. Torsion Spring: Adjustable-tension torsion springs complying with requirements of DASMA 102 for number of operation cycles indicated, mounted on torsion shaft.
  2. Cable Drums and Shaft for Doors: Cast-aluminum cable drums mounted on torsion shaft and grooved to receive door-lifting cables as door is raised.

- a. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of torsion shaft.
  3. Cables: Galvanized-steel, multistrand, lifting cables.
  4. Cable Safety Device: Include a spring-loaded steel or bronze cam mounted to bottom door roller assembly on each side and designed to automatically stop door if lifting cable breaks.
  5. Bracket: Provide anchor support bracket as required to connect stationary end of spring to the wall and to level the shaft and prevent sag.
  6. Bumper: Provide spring bumper at each horizontal track to cushion door at end of opening operation.
- M. Electric Door Operator: Electric door operator assembly of size and capacity recommended by door manufacturer for door and operation cycles specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
1. Comply with NFPA 70.
  2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6; with NFPA 70, Class 2 control circuit, maximum 24 V ac or dc.
  3. Safety: Listed in accordance with UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 ft. or lower.
  4. Usage Classification: Heavy duty, 25 or more cycles per hour and more than 90 cycles per day.
  5. Operator Type: Jackshaft, side mounted. Operators to be stack mounted at Column line 1
    - a. Basis of Design Model: Overhead Door Corporation Model RHX
  6. Motor: Reversible-type for interior, clean, and dry motor exposure. Use adjustable motor-mounting bases for belt-driven operators.
    - a. Motor Size: 1/2 hp.
    - b. Electrical Characteristics:
      - 1) Phase: Single phase.
      - 2) Volts: 115 V.
  7. Limit Switches: Equip motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
  8. Obstruction Detection: Automatic external entrapment protection consisting of automatic safety sensor capable of protecting full width of door opening. Activation of device immediately stops and reverses downward door travel.
    - a. Monitored Entrapment Protection: Photoelectric sensor Electric sensor edge on bottom section designed to interface with door-operator control circuit to detect damage to or disconnection of sensor and complying with requirements in UL 325.
      - 1) Provide Photoelectric sensor mounted at 26 inches above floor at Door 103.1
  9. Control Station: Surface mounted, three-position (open, close, and stop) control.

- a. Operation: Push button.
  - b. Interior-Mounted Unit: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
  - c. Exterior access control: Keypad/Cardreader provided under electrical contract.
10. Emergency Manual Operation: Chain type designed so required force for door operation does not exceed 25 lbf.
  11. Emergency Operation Disconnect Device: Hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
  12. Motor Removal: Design operator so motor can be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

N. Metal Finish:

1. Factory Prime Steel Finish: Compatible with field-applied finish and in manufacturer's standard color.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install sectional doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; in accordance with manufacturer's written instructions.
- B. Tracks:
  1. Fasten vertical track assembly to opening jambs and framing with fasteners spaced not more than 24 inches apart.
  2. Hang horizontal track assembly from structural overhead framing with angles or channel hangers attached to framing by welding or bolting, or both. Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.
- C. Accessibility: Install sectional doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.
- D. Power-Operated Doors: Install in accordance with UL 325.

#### 3.2 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain sectional doors.

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City of Rye, NY

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END OF SECTION 083613

## SECTION 088000 - GLAZING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Glass products.
2. Insulating glass.
3. Glazing sealants.
4. Glazing tapes.
5. Miscellaneous glazing materials.

#### 1.2 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For glass.
- B. Product test reports.
- C. Preconstruction adhesion and compatibility test report.
- D. Sample warranties.

1.5 QUALITY ASSURANCE

- A. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.

1.6 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.

- B. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.



## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazing.
- B. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined in accordance with the IBC and ASTM E1300:
  - 1. Design Wind Pressures: As indicated on Drawings.
  - 2. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
- C. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
- D. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
  - 1. U-Factors: Center-of-glazing values, in accordance with NFRC 100 and based on LBL's WINDOW 7 computer program, expressed as Btu/sq. ft. x h x deg F.

2. SHGC and Visible Transmittance: Center-of-glazing values, in accordance with NFRC 200 and based on LBL's WINDOW 7 computer program.
3. Visible Reflectance: Center-of-glazing values, in accordance with NFRC 300.

## 2.2 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
  1. NGA Publications: "Glazing Manual."
  2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR A7, "Sloped Glazing Guidelines."
  3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
  4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the IGCC.
- D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than thickness indicated.
- E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

## 2.3 GLASS PRODUCTS

### A. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. AGC Glass Company North America, Inc.
  - b. Guardian Glass; SunGuard.
  - c. Pilkington North America.

### B. Tinted Annealed Float Glass: ASTM C1036, Type I, Class 2 (tinted), Quality-Q3.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. AGC Glass Company North America, Inc.
  - b. Guardian Glass; SunGuard.
  - c. Pilkington North America.

### C. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

### D. Heat-Strengthened Float Glass: ASTM C1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

### E. Low-E-Coated Vision Glass: ASTM C1376.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Guardian Glass; SunGuard.
  - b. Pilkington North America.
  - c. Viracon, Inc.

## 2.4 INSULATING GLASS

### A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified in accordance with ASTM E2190.

1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
2. Perimeter Spacer: Warm edge spacer material and construction.

3. Desiccant: Molecular sieve or silica gel, or a blend of both.

## 2.5 GLAZING SEALANTS

### A. General:

1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range of industry colors.

- B. Neutral-Curing Silicone Glazing Sealant, Class 50: Complying with ASTM C920, Type S, Grade NS, Use NT.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- a. GE Construction Sealants; Momentive Performance Materials Inc.
- b. Sika Corporation.
- c. Tremco Incorporated.

## 2.6 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:

- 1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
- 2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

- 1. AAMA 810.1, Type 1, for glazing applications in which tape acts as primary sealant.
- 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

## 2.7 MISCELLANEOUS GLAZING MATERIALS

- A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- B. Setting Blocks:

1. Type recommended in writing by sealant or glass manufacturer.
- C. Spacers:
  1. Type recommended in writing by sealant or glass manufacturer.
- D. Edge Blocks:
  1. Type recommended in writing by sealant or glass manufacturer.
- E. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

### PART 3 - EXECUTION

#### 3.1 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and in accordance with requirements in referenced glazing publications.
- H. Provide safety glazing in operable doors, glazing panels adjacent to operable doors, and glazing panels within 18 inches of floor surface.

### 3.2 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Apply heel bead of elastomeric sealant.
- F. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- G. Apply cap bead of elastomeric sealant over exposed edge of tape.

### 3.3 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.

- E. Install gaskets so they protrude past face of glazing stops.

### 3.4 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

### 3.5 CLEANING AND PROTECTION

- A. Immediately after installation, remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
  - 1. If, despite such protection, contaminating substances do contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.

### 3.6 INSULATING GLASS SCHEDULE

- A. Low-E-Coated, Insulating Glass Type 1 (Drawing Indication GL1, and Exterior Doors):
  - 1. Basis-of-Design Product: Guardian Glass, SunGuard, SN 68 UltraClear (Outboard), UltraClear (Inboard).



2. Overall Unit Thickness: 1 inch.
3. Minimum Thickness of Each Glass Lite: 6mm
4. Outdoor Lite: Fully tempered float glass.
5. Color: UltraClear.
6. Interspace Content: Argon.
7. Indoor Lite: Fully tempered float glass.
8. Color: UltraClear
9. Low-E Coating: Pyrolytic or sputtered on second surface.
10. Solar Control: 0.39 SHGC.
11. Transmittance: 71%
12. Reflect out: 11%
13. Reflect in: 13%
14. U-value: .245

END OF SECTION 088000

## SECTION 089119 - FIXED LOUVERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes fixed extruded-aluminum louvers.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
- B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
- C. Samples: For each type of metal finish required.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on tests performed according to AMCA 500-L.
- B. Sample warranties.

#### 1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:

- 1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

## 1.5 WARRANTY

- A. Special Finish Warranty: Manufacturer agrees to repair or replace components on which finishes fail in materials or workmanship within specified warranty period.

- 1. Warranty Period: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

- 1. Wind Loads: Determine loads based on pressures as indicated on Drawings.

- B. Seismic Performance: As indicated on drawings.

## 2.2 FIXED EXTRUDED-ALUMINUM LOUVERS

### A. Horizontal Drainable-Blade Louver: L-3

1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Greenheck Fan Corporation.
  - b. Reliable Products, Inc.
  - c. Ruskin Company.
2. Louver Depth: 4 inches.
3. Frame and Blade Nominal Thickness: Not less than 0.080 inch.
4. Mullion Type: Exposed.
5. Louver Performance Ratings:
  - a. Free Area: Not less than 8.0 sq. ft. for 48-inch-wide by 48-inch-high louver.
  - b. Point of Beginning Water Penetration: Not less than 900 fpm.
  - c. Air Performance: Not more than 0.10-inch wg static pressure drop at 800-fpm free-area exhaust velocity.
  - d. Air Performance: Not more than 0.15-inch wg static pressure drop at 1000-fpm free-area exhaust velocity.

6. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

## 2.3 LOUVER SCREENS

- A. General: Provide screen at each exterior louver.
  1. Screen Location for Fixed Louvers: Interior face.
  2. Screening Type: Insect screening.
- B. Louver Screen Frames: Same type and form of metal as indicated for louver to which screens are attached.
- C. Louver Screening for Aluminum Louvers:
  1. Insect Screening: Aluminum, 18-by-16 mesh, 0.012-inch wire.

## 2.4 MATERIALS

- A. Aluminum Extrusions: ASTM B221, Alloy 6063-T5, T-52, or T6.
- B. Aluminum Sheet: ASTM B209, Alloy 3003 or 5005, with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Fasteners: Use types and sizes to suit unit installation conditions.

1. Use hex-head or Phillips pan-head screws for exposed fasteners unless otherwise indicated.
  2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
  3. For color-finished louvers, use fasteners with heads that match color of louvers.
- D. Post-installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, fabricated from stainless-steel components, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing according to ASTM E488/E488M conducted by a qualified testing agency.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

## 2.5 FABRICATION

- A. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
- B. Join frame members to each other and to fixed louver blades with fillet welds concealed from view, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

## 2.6 ALUMINUM FINISHES

- A. High-Performance Organic Finish: Three-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 50 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

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

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- D. Protect unpainted galvanized- and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

#### 3.2 ADJUSTING

- A. Restore louvers damaged during installation and construction, so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

END OF SECTION 089119

## SECTION 092116.23 - GYPSUM BOARD SHAFT WALL ASSEMBLIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Gypsum board shaft wall assemblies.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each component of gypsum board shaft wall assembly.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.



## 2.2 GYPSUM BOARD SHAFT WALL ASSEMBLIES

- A. Fire-Resistance Rating: 1 hour 3 hours 4 hours Insert rating.
- B. Gypsum Shaftliner Board:
  - 1. Moisture- and Mold-Resistant Type X: ASTM C1396/C1396M; manufacturer's proprietary fire-resistive liner panels with ASTM D3273 mold-resistance score of 10 as rated according to ASTM D3274, 1 inch thick, and with double beveled long edges.
    - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      - 1) American Gypsum.
      - 2) CertainTeed; SAINT-GOBAIN.
      - 3) Gold Bond Building Products, LLC provided by National Gypsum Company.
      - 4) USG Corporation.
- C. Non-Load-Bearing Steel Framing, General: Complying with ASTM C645 requirements for metal unless otherwise indicated and complying with requirements for fire-resistance-rated assembly indicated.
- D. Studs: Manufacturer's standard profile for repetitive, corner, and end members as follows:
  - 1. Depth: 4 inches.
  - 2. Minimum Base-Metal Thickness: 0.030 inch.
- E. Runner Tracks: Manufacturer's standard J-profile track with manufacturer's standard long-leg length, but at least 2 inches long and matching studs in depth.

1. Minimum Base-Metal Thickness: 0.030 inch.

F. Finish Panels: Gypsum board as specified in Section 092900 "Gypsum Board".

## 2.3 AUXILIARY MATERIALS

- A. Trim Accessories: Cornerbead, edge trim, and control joints of material and shapes as specified in Section 092900 "Gypsum Board" that comply with gypsum board shaft wall assembly manufacturer's written instructions for application indicated.
- B. Steel Drill Screws: ASTM C1002 unless otherwise indicated.
- C. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.
- D. Reinforcing: Galvanized-steel reinforcing strips with 0.033-inch minimum thickness of base metal (uncoated).

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. General: Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated and manufacturer's written installation instructions.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.

- C. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels while maintaining continuity of fire-rated construction.
- D. Firestop Tracks: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
- E. Remove and replace panels that are wet, moisture damaged, or mold damaged.

END OF SECTION 092116.23

## PART 1 - GENERAL

### 1.1 SUMMARY

- A. Section Includes:
  - 1. Framing systems.
  - 2. Suspension systems.

### 1.2 ACTION SUBMITTALS

- A. Product Data: For each product.

### 1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of code-compliance certification for studs and tracks.
- B. Evaluation reports for high-strength steel studs and tracks.

### 1.4 QUALITY ASSURANCE

- A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association, the Steel Framing Industry Association, or the Steel Stud Manufacturers Association.

## PART 2 - PRODUCTS

### 2.1 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C645 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C645 requirements for metal unless otherwise indicated
  2. Protective Coating: Comply with ASTM C645; ASTM A653/A653M, G40; or coating with equivalent corrosion resistance. Galvannealed products are unacceptable.
    - a. Coating demonstrates equivalent corrosion resistance with an evaluation report acceptable to authorities having jurisdiction.
- B. Studs and Track: ASTM C645.
1. Minimum Base-Steel Thickness: 0.0296 inch.
  2. Depth: As indicated on Drawings.
- C. High-Strength Steel Studs and Tracks: Roll-formed with surface deformations to stiffen the framing members.
1. Minimum Base-Steel Thickness: 0.0180 inch.
  2. Depth: As indicated on Drawings.
- D. Slip-Type Head Joints: Where indicated, provide one of the following:
1. Clip System: Clips designed for use in head-of-wall deflection conditions that provide a positive attachment of studs to tracks while allowing 2-inch 2-1/2-inch 3-inch Insert dimension minimum vertical movement.
  2. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

- E. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. ClarkDietrich.
  - 2. Marino\WARE.
  - 3. SCAFCO Steel Stud Company; Stone Group of Companies.
- F. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
  - 1. Minimum Base-Steel Thickness: 0.0296 inch.
- G. Cold-Rolled Channel Bridging: Steel, 0.0538-inch minimum base-steel thickness, with minimum 1/2-inch-wide flanges.
  - 1. Depth: 1-1/2 inches.
  - 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch-thick, galvanized steel.
- H. Hat-Shaped, Rigid Furring Channels:
  - 1. Minimum Base-Steel Thickness: 0.0179 inch.
  - 2. Depth: 1-1/2 inches.

## 2.2 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
  - 1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide one of the following:
  - 1. Asphalt-Saturated Organic Felt: ASTM D226/D226M, Type I (No. 15 asphalt felt), nonperforated.
  - 2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C754.
  - 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.

#### 3.2 INSTALLATION OF FRAMING SYSTEMS

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
  - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
  - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.

- a. Install two studs at each jamb unless otherwise indicated.
  - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
  - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
- 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
- E. Direct Furring:
  - 1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
- F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

### 3.3 FIELD QUALITY CONTROL

- A. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216



## SECTION 092900 - GYPSUM BOARD

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Tile backing panels.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Gypsum wallboard.
2. Gypsum ceiling board.
3. Cementitious tile backing panels.
4. Interior trim.
5. Joint treatment materials.
6. Sound-attenuation blankets.
7. Acoustical sealant.

#### 1.3 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

#### 1.4 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, and mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

### PART 2 - PRODUCTS

#### 2.1 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

#### 2.2 INTERIOR GYPSUM BOARD

- A. Gypsum Wallboard: ASTM C1396/C1396M.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Georgia-Pacific Gypsum LLC.
    - b. National Gypsum Company.
    - c. USG Corporation.
  - 2. Thickness: 5/8 inch.
  - 3. Type X
  - 4. Long Edges: Tapered.
- B. Gypsum Ceiling Board: ASTM C1396/C1396M.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Georgia-Pacific Gypsum LLC.

- b. National Gypsum Company.
- c. USG Corporation.

- 2. Thickness: 5/8 inch.
- 3. Type X
- 4. Long Edges: Tapered.

## 2.3 TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A118.9 and ASTM C1288 or ASTM C1325, with manufacturer's standard edges.

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Certainteed; SAINT-GOBAIN.
  - b. National Gypsum Company.
  - c. USG Corporation.
- 2. Thickness: 5/8 inch.
- 3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

## 2.4 TRIM ACCESSORIES

- A. Interior Trim: ASTM C1047.
  - 1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.
  - 2. Shapes:
    - a. Cornerbead.
    - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
    - c. L-Bead: L-shaped; exposed long flange receives joint compound.
    - d. Expansion (control) joint.

## 2.5 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C475/C475M.
- B. Joint Tape:

1. Interior Gypsum Board: Paper.
  2. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
  2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
    - a. Use setting-type compound for installing paper-faced metal trim accessories.
  3. Fill Coat: For second coat, use drying-type, all-purpose compound.
  4. Finish Coat: For third coat, use drying-type, all-purpose compound.
- D. Joint Compound for Tile Backing Panels:
1. Cementitious Backer Units: As recommended by backer unit manufacturer.
- E. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- F. Steel Drill Screws: ASTM C1002 unless otherwise indicated.
1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
- G. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
- H. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."
- I. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

### PART 3 - EXECUTION

#### 3.1 INSTALLATION AND FINISHING OF PANELS

- A. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- B. Comply with ASTM C840.

- C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- D. For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- E. Prefill open joints and damaged surface areas.
- F. Install Sound Attenuation Blankets in all partition cavities
- G. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- H. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:
  - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
  - 2. Level 2: Panels that are substrate for tile.
  - 3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
    - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

### 3.2 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.

END OF SECTION 092900

## SECTION 096513 - RESILIENT BASE AND ACCESSORIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Thermoset-rubber base.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

### PART 2 - PRODUCTS

#### 2.1 THERMOSET-RUBBER BASE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Roppe
2. Flexco.
3. Johnsonite; a Tarkett company.

- B. Product Standard: ASTM F1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).

- 1. Style and Location:

- a. As indicated on Finish Plans A-103, and A-104

- C. Thickness: 0.125 inch.
- D. Height: 4 inches.
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Job formed or preformed.
- G. Inside Corners: Job formed.
- H. Colors: Black.

## 2.2 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.
  - 1. Verify adhesives have a VOC content of 50 g/L or less.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

- C. Do not install resilient products until materials are the same temperature as space where they are to be installed.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

### 3.2 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.
- H. Job-Formed Corners:
  - 1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 4 inches in length.
    - a. Form without producing discoloration (whitening) at bends.
  - 2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 4 inches in length.
    - a. Cope corners to minimize open joints.

### 3.3 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.



END OF SECTION 096513

## SECTION 099113 - EXTERIOR PAINTING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes surface preparation and the application of paint systems on exterior substrates.
  - 1. Concrete.
  - 2. Steel.
  - 3. Galvanized metal.

#### 1.2 DEFINITIONS

- A. MPI Gloss Level 1 (Matte finish – flat): Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.
- B. MPI Gloss Level 3 (Eggshell-like): 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- C. MPI Gloss Level 4 (Satin-like): 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.
- D. MPI Gloss Level 5 (Semi-gloss) : 35 to 70 units at 60 degrees, according to ASTM D523.
- E. MPI Gloss Level 6 (Gloss): 70 to 85 units at 60 degrees, according to ASTM D523.
- F. MPI Gloss Level 7 (High-gloss): More than 85 units at 60 degrees, according to ASTM D523.

### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
  - 1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
- B. Samples: For each type of paint system and each color and gloss of topcoat.
- C. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

### 1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

### 1.5 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
    - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft..
    - b. Other Items: Architect will designate items or areas required.
  - 2. Final approval of color selections will be based on mockups.
    - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
  - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
  1. Maintain containers in clean condition, free of foreign materials and residue.
  2. Remove rags and waste from storage areas daily.

#### 1.7 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
- C. Do not apply paints when surface and environmental conditions do not comply with paint manufacturer's written recommendations.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  1. Behr Paint Company; Behr Process Corporation.
  2. Benjamin Moore & Co.
  3. PPG Paints.
  4. Sherwin-Williams Company (The).

- B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include but are not limited to products listed in the Exterior Painting Schedule for the paint category indicated.

## 2.2 PAINT, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."
- B. Material Compatibility:
  - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- C. VOC Content: For field applications, verify paints and coatings comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:
  - 1. Flat Paints and Coatings: 50 g/L.
  - 2. Nonflat Paints and Coatings: 50 g/L.
  - 3. Primers, Sealers, and Undercoaters: 100 g/L.
  - 4. Rust-Preventive Coatings: 100 g/L.
  - 5. Pretreatment Wash Primers: 420 g/L.
- D. Colors: As selected by Architect from manufacturer's full range.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  - 1. Concrete: 12 percent.
  - 2. Masonry (CMUs): 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
  - 1. Application of coating indicates acceptance of surfaces and conditions.

#### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale. Clean using methods recommended in writing by paint manufacturer. Verify compatibility of shop primer, if any.
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

### 3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
  - 1. Use applicators and techniques suited for paint and substrate indicated.
  - 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
  - 3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
  - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- C. Apply paints to manufacturer's recommended dry film thickness (DFT), to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- D. Painting Plumbing, HVAC, Electrical, Work:
  1. Paint the following work where exposed to view:
    - a. Equipment, including panelboards.
    - b. Uninsulated metal piping.
    - c. Metal conduit.

### 3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### 3.5 EXTERIOR PAINTING SCHEDULE



A. Concrete Substrates, Nontraffic Surfaces:

1. Water-Based Light Industrial Coating System MPI EXT 3.1C-G3:

- a. Prime Coat: Primer, alkali resistant, water based, MPI #3.
  - 1) PPG Architectural; PPG Paints, Seal Grip Int/Ext Acrylic Universal Primer/Sealer.
  - 2) Rust-Oleum; Zinsser, AllPrime Interior-Exterior Primer Sealer.
  - 3) Sherwin Williams; Loxon, Loxon Concrete & Masonry Primer.
- b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
- c. Topcoat: Light industrial coating, exterior, water based (MPI Gloss Level 3), MPI #161.
  - 1) PPG Architectural; High Performance Coatings, Devflex 4212HP Waterborne Acrylic Eggshell Enamel.
  - 2) Rust-Oleum; Rust Oleum, Industrial Choice 5200 System DTM Acrylic.
  - 3) Sherwin Williams; Pro Industrial, DTM Acrylic Eg-Shel.

B. Steel Substrates:

1. Water-Based Light Industrial Coating System MPI EXT 5.1C-G5:

- a. Prime Coat: Shop primer specified in Section where substrate is specified.
- b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
- c. Topcoat: Light industrial coating, exterior, water based, semi-gloss (MPI Gloss Level 5), MPI #163.
  - 1) Behr; Behr Premium, Int/Ext Direct to Metal Semi-Gloss Paint.
  - 2) Rust-Oleum; Rust Oleum, 3800 System DTM Acrylic Enamel.
  - 3) Sherwin Williams; Pro Industrial, DTM Semi-Gloss.

C. Galvanized-Metal Substrates:

1. Water-Based Light Industrial Coating System MPI EXT 5.3J-G5:
  - a. Prime Coat: Primer, galvanized, water based, MPI #134.
    - 1) Behr Paint; Premium Plus, Exterior Multi-Surface Primer & Sealer.
    - 2) Rust-Oleum; Rust Oleum, Sierra Performance Griptec Multi Surface Primer.
    - 3) Sherwin Williams; Pro Industrial, Pro-Cryl Universal Primer.
  - b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
  - c. Topcoat: Light industrial coating, exterior, water based, semi-gloss (MPI Gloss Level 5), MPI #163.
    - 1) Behr; Behr Premium, Int/Ext Direct to Metal Semi-Gloss Paint.
    - 2) Rust-Oleum; Rust Oleum, 3800 System DTM Acrylic Enamel.
    - 3) Sherwin Williams; Pro Industrial, DTM Semi-Gloss.

END OF SECTION 099113

## SECTION 099123 - INTERIOR PAINTING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes surface preparation and the application of paint systems on interior substrates.
  - 1. Concrete.
  - 2. Concrete masonry units (CMUs).
  - 3. Steel
  - 4. Galvanized metal.
  - 5. Gypsum board.

#### 1.2 DEFINITIONS

- A. MPI Gloss Level 1 (Matte-finish – flat): Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.
- B. MPI Gloss Level 2 (High side sheen flat - velvet-like): Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- C. MPI Gloss Level 3 (Eggshell-like): 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- D. MPI Gloss Level 4 (Satin-like): 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.

- E. MPI Gloss Level 5 (Semi-gloss): 35 to 70 units at 60 degrees, according to ASTM D523.
- F. MPI Gloss Level 6 (Gloss): 70 to 85 units at 60 degrees, according to ASTM D523.
- G. MPI Gloss Level 7 (High-gloss): More than 85 units at 60 degrees, according to ASTM D523.

### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
  - 1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
  - 2. Indicate VOC content.
- B. Samples: For each type of paint system and in each color and gloss of topcoat.
- C. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
  - 1. Maintain containers in clean condition, free of foreign materials and residue.
  - 2. Remove rags and waste from storage areas daily.

### 1.5 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
- C. Do not apply paints when surface and environmental conditions do not comply with paint manufacturer's written recommendations.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Behr Paint Company; Behr Process Corporation.
  - 2. PPG Paints.
  - 3. Benjamin Moore & Co.
  - 4. Sherwin-Williams Company (The).
- B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in the Interior Painting Schedule for the paint category indicated.

### 2.2 PAINT, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."
- B. Material Compatibility:
  - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- C. VOC Content: For field applications that are inside the weatherproofing system, verify paints and coatings comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:
  - 1. Flat Paints and Coatings: 50 g/L.
  - 2. Nonflat Paints and Coatings: 50 g/L.
  - 3. Primers, Sealers, and Undercoaters: 100 g/L.
  - 4. Rust-Preventive Coatings: 100 g/L.
  - 5. Zinc-Rich Industrial Maintenance Primers: 100 g/L.
  - 6. Pretreatment Wash Primers: 420 g/L.
- D. Colors: As selected by Architect from manufacturer's full range.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  - 1. Concrete: 12 percent.
  - 2. Masonry (CMUs): 12 percent.
  - 3. Wood: 15 percent.
  - 4. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
  - 1. Application of coating indicates acceptance of surfaces and conditions.

#### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

### 3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
  - 1. Use applicators and techniques suited for paint and substrate indicated.
  - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
  - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
  - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- C. Apply paints to manufacturer's recommended dry film thickness (DFT), to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- D. Painting Fire Suppression, Plumbing, HVAC, Electrical, and Exposed Steel:
  - 1. Paint the following work where exposed in occupied spaces:
    - a. Exposed structural steel.
    - b. Uninsulated metal piping.
    - c. Pipe hangers and supports.
    - d. Metal conduit.

### 3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### 3.5 INTERIOR PAINTING SCHEDULE

- A. Concrete Substrates, Nontraffic Surfaces:
  - 1. Water-Based Light Industrial Coating System MPI INT 3.1L-G5:
    - a. Prime Coat: Primer, alkali resistant, water based, MPI #3.
      - 1) Behr Paint; Premium Plus, Exterior Multi-Surface Primer & Sealer.
      - 2) PPG Architectural; PPG Paints, Seal Grip Int/Ext Acrylic Universal Primer/Sealer.
      - 3) Sherwin Williams; Loxon, Loxon Concrete & Masonry Primer.
    - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
    - c. Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5), MPI #153.
      - 1) Behr Paint; Behr Pro HPC, Pre-Catalyzed WB Epoxy Semi-Gloss.
      - 2) PPG Architectural; PPG Paints, Pitt-Glaze WB1 Int. Semi-Gloss Pre-Catalyzed WB Acrylic Epoxy.



- 3) Sherwin Williams; Pro Industrial, Pro Industrial Pre-Cat Epoxy Semi-Gloss.

B. CMU Substrates:

1. Water-Based Light Industrial Coating System MPI INT 4.2K-G5:

- a. Block Filler: Block filler, latex, interior/exterior, MPI #4.
  - 1) Behr Paint; Behr Pro, Block Filler.
  - 2) PPG Architectural; PPG Paints, Speedhide Int./Ext. Masonry Hi Fill Latex Block Filler.
  - 3) Sherwin Williams; PrepRite, Int/Ext Block Filler.
- b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
- c. Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5), MPI #153.
  - 1) Behr Paint; Behr Pro HPC, Pre-Catalyzed WB Epoxy Semi-Gloss.
  - 2) PPG Architectural; PPG Paints, Pitt-Glaze WB1 Int. Semi-Gloss Pre-Catalyzed WB Acrylic Epoxy.
  - 3) Sherwin Williams; Pro Industrial, Pro Industrial Pre-Cat Epoxy Semi-Gloss.

C. Steel Substrates:

1. Water-Based Light Industrial Coating System MPI INT 5.1B-G5:

- a. Prime Coat: Primer, rust-inhibitive, water based MPI #107.
  - 1) Behr Paint; Premium Plus, Exterior Multi-Surface Primer & Sealer.
  - 2) PPG Architectural; High Performance Coatings, Pitt-Tech Int/Ext DTM Industrial Primer.
  - 3) Sherwin Williams; Pro Industrial, Pro-Cryl Universal Primer.

- b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
- c. Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5), MPI #153.
  - 1) Behr Paint; Behr Pro HPC, Pre-Catalyzed WB Epoxy Semi-Gloss.
  - 2) PPG Architectural; PPG Paints, Pitt-Glaze WB1 Int. Semi-Gloss Pre-Catalyzed WB Acrylic Epoxy.
  - 3) Sherwin Williams; Pro Industrial, Pro Industrial Pre-Cat Epoxy Semi-Gloss.

D. Galvanized-Metal Substrates:

1. Water-Based Light Industrial Coating System MPI INT 5.3B-5G:

- a. Prime Coat: Primer, galvanized, water based, MPI #134.
  - 1) Behr Paint; Premium Plus, Exterior Multi-Surface Primer & Sealer.
  - 2) PPG Architectural; High Performance Coatings, Pitt-Tech Plus 4020 PF / Devflex 4020 PF.
  - 3) Sherwin Williams; Pro Industrial, Pro-Cryl Universal Primer.
- b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
- c. Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5), MPI #153.
  - 1) Behr Paint; Behr Pro HPC, Pre-Catalyzed WB Epoxy Semi-Gloss.
  - 2) PPG Architectural; PPG Paints, Pitt-Glaze WB1 Int. Semi-Gloss Pre-Catalyzed WB Acrylic Epoxy.
  - 3) Sherwin Williams; Pro Industrial, Pro Industrial Pre-Cat Epoxy Semi-Gloss.

E. Gypsum Board Substrates:

1. Institutional Low-Odor/VOC Latex System MPI INT 9.2M-G3:

- a. Prime Coat: Primer sealer, interior, institutional low odor/VOC, MPI #149.
    - 1) Behr Paint; Premium Plus, Interior All-in-One Primer.
    - 2) PPG Architectural; PPG Paints, Speedhide Zero Interior Zero VOC Latex Sealer.
    - 3) Sherwin Williams; ProMar 200, Zero Interior Latex Primer.
  - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
  - c. Topcoat: Latex, interior, institutional low odor/VOC, eggshell-like (MPI Gloss Level 3), MPI #145.
    - 1) Behr Paint; Premium Plus, Interior Eggshell Paint.
    - 2) PPG Architectural; Dulux (CA), Ultra Zero VOC Int Latex Pearl.
    - 3) Sherwin Williams; ProMar 200 HP Zero VOC, Interior Acrylic Eg-Shel.
- F. Steel Deck Applications: Water-Based Dry-Fall System:
- 1. Prime Coat: Shop primer specified in Section where substrate is specified.
  - 2. Topcoat: Dry fall, latex, flat, MPI #118.
    - a. Behr Paint; Behr PRO, Dryfall White.
    - b. PPG Architectural; PPG Paints, Speedhide Super Tech WB Interior Dry Fog Flat Latex.
    - c. Sherwin Williams; Pro Industrial, Waterborne Acrylic Dry Fall

END OF SECTION 099123

## SECTION 101423.16 - ROOM-IDENTIFICATION PANEL SIGNAGE

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes room-identification signs that are directly attached to the building.
- B. Scope: Provide room identification signage for all interior, enclosed spaces.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For room-identification signs.
  - 1. Include fabrication and installation details and attachments to other work.
  - 2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
  - 3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.
- C. Samples: For each exposed product and for each color and texture specified.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Sample warranty.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

## 1.5 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.
  - 1. Tactile characters shall be raised the required 1/32" inches from sign face. Glue-on letters or etched backgrounds are not acceptable.
  - 2. All text shall be accompanied by Grade 2 braille. Braille shall be separated 1/2" from the corresponding raised characters or symbols. Grade 2 braille translation to be provided by signage manufacturer.
  - 3. All letters, numbers and/or symbols shall contrast with their background, either light characters on a dark background or dark characters on a light background. Characters and background shall have a non-glare finish.

### 2.2 ROOM-IDENTIFICATION SIGNS

- A. Room-Identification Sign: Sign system with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. ASI Sign Systems, Inc.
    - b. Cosco.
    - c. Mohawk Sign Systems.
  - 2. Laminated-Sheet Sign: Photopolymer or Sandblasted polymer face sheet with raised graphics laminated to phenolic backing sheet to produce composite sheet.
    - a. Composite-Sheet Thickness: Manufacturer's standard for size of sign.
    - b. Surface-Applied Graphics: Applied vinyl film.
    - c. Subsurface Graphics: Phot image or Slide-in changeable insert.
    - d. Color(s): As selected by Architect from manufacturer's full range.

3. Sign-Panel Perimeter: Finish edges smooth.
  - a. Edge Condition: Square cut.
  - b. Corner Condition in Elevation: Rounded to manufacturer's recommended radius.
4. Mounting: Surface mounted to wall with concealed anchors.

## 2.3 SIGN MATERIALS

- A. Acrylic Sheet: ASTM D4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).
- B. Vinyl Film: UV-resistant vinyl film with pressure-sensitive, permanent adhesive; die cut to form characters or images as indicated on Drawings and suitable for exterior applications.

## 2.4 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:
  1. Use concealed fasteners and anchors unless indicated to be exposed.
  2. For exterior exposure, furnish nonferrous-metal or hot-dip galvanized devices.
  3. Exposed Metal-Fastener Components, General:
    - a. Fabricated from same basic metal and finish of fastened sign unless otherwise indicated.

4. Sign Mounting Fasteners:

- a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly unless otherwise indicated.
- b. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, and installed in predrilled holes.

B. Adhesive: As recommended by sign manufacturer.

C. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.

2.5 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
2. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
3. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

B. Subsurface-Applied Graphics: Apply graphics to back face of clear face-sheet material to produce precisely formed image. Image shall be free of rough edges.

C. Subsurface-Etched Graphics: Reverse etch back face of clear face-sheet material. Fill resulting copy with manufacturer's standard enamel. Apply opaque manufacturer's standard background color coating over enamel-filled copy.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Install signs so they do not protrude or obstruct according to the accessibility standard.
3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.

B. Mounting Methods:

1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
  - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
  - b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.
2. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
3. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
4. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position and push to engage tape adhesive.

END OF SECTION 101423.16



## SECTION 102113.17 - PHENOLIC-CORE TOILET COMPARTMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Phenolic-core toilet compartments.

#### 1.2 ACTION SUBMITTALS

A. Product data.

B. Shop Drawings:

1. Plans, elevations, sections, details, and attachment details.

C. Samples: Manufacturer's standard color sheets, showing full range of available colors for each type of toilet compartment.

#### 1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84; 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: 450 or less.

B. Regulatory Requirements: Comply with applicable provisions in ICC A117.1 for toilet compartments designated as accessible.

#### 2.2 PHENOLIC-CORE TOILET COMPARTMENTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. ASI Accurate Partitions.

2. Bobrick Washroom Equipment, Inc.
  3. Bradley Corporation.
  4. General Partitions Mfg. Corp.
  5. Knickerbocker Partition Corporation.
- B. Toilet-Enclosure Style: Overhead braced.
- C. Entrance-Screen Style: Overhead braced.
- D. Urinal-Screen Style: Wall hung.
- E. Door, Panel, and Pilaster Construction: Solid phenolic-core material with melamine facing on both sides fused to substrate during manufacture (not separately laminated), and with eased and polished edges. Provide minimum 3/4-inch-thick doors and pilasters and minimum 1/2-inch-thick panels.

- F. Entrance-Screen Construction: Matching panel construction.
- G. Urinal-Screen Construction: Matching panel construction.
- H. Pilaster Shoes: Formed from stainless steel sheet, not less than 0.031-inch nominal thickness and 3 inches high, finished to match hardware.
- I. Pilaster Sleeves (Caps): Formed from stainless steel sheet, not less than 0.031-inch nominal thickness and 3 inches high, finished to match hardware.
- J. Brackets (Fittings):
  - 1. Full-Height (Continuous) Type: Manufacturer's standard design, stainless steel.
- K. Phenolic Compartment Finish: One color.
  - 1. Through-Color Phenolic: Manufacturer's standard solid through-color.
    - a. Color: As selected by Architect from manufacturer's full range.

## 2.3 HARDWARE AND ACCESSORIES

- A. Door Hardware and Accessories: Manufacturer's operating hardware and accessories.
  - 1. Hinges: Manufacturer's standard, allowing emergency access by lifting door.
  - 2. Latch and Keeper: Manufacturer's standard stainless steel, surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and

- keeper. Provide units that comply with regulatory requirements for accessibility at toilet enclosures designated as accessible.
3. Coat Hook: Manufacturer's standard stainless steel combination hook and rubber-tipped bumper, sized to prevent inswinging door from hitting compartment-mounted accessories.
  4. Door Pull: Manufacturer's standard stainless steel pull at outswinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at toilet enclosures designated as accessible.
- B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.
- C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel compatible with related materials.

## 2.4 MATERIALS

- A. Aluminum Castings: ASTM B26/B26M.
- B. Aluminum Extrusions: ASTM B221.
- C. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.
- D. Stainless Steel Castings: ASTM A743/A743M.

## 2.5 FABRICATION

- A. Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.

- B. Overhead-Braced Units: Manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters and walls to suit floor and wall conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
- C. Door Size and Swings: Unless otherwise indicated, provide 24-inch-wide, inswinging doors for standard toilet enclosures and 36-inch-wide, outswinging doors with a minimum 32-inch-wide, clear opening for toilet enclosures designated as accessible.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
  - 1. Maximum Clearances:
    - a. Pilasters and Panels or Screens: 1/2 inch.
    - b. Panels or Screens and Walls: 1 inch.
  - 2. Full-Height (Continuous) Brackets: Secure panels or screens to walls and to pilasters with full-height brackets.
    - a. Align brackets at pilasters with brackets at walls.
- B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.
- C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

### 3.2 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware in accordance with hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 102113.17

## SECTION 104413 - FIRE PROTECTION CABINETS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Fire-protection cabinets for portable fire extinguishers.

#### 1.2 PREINSTALLATION CONFERENCE

- ##### A. Preinstallation Conference: Conduct conference at Project site.

#### 1.3 ACTION SUBMITTALS

- ##### A. Product Data: For each type of product.
- ##### B. Shop Drawings: For fire-protection cabinets.
- ##### C. Samples: For each type of exposed finish required.

#### 1.4 CLOSEOUT SUBMITTALS

- ##### A. Maintenance data.

#### 1.5 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

## PART 2 - PRODUCTS

### 2.1 FIRE-PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. JL Industries, Inc.; a division of the Activar Construction Products Group.
    - b. Larsens Manufacturing Company.
    - c. Nystrom.
- B. Cabinet Construction: Nonrated.
- C. Cabinet Material: Clear anodized aluminum.



- D. Semi-recessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).
  - 1. 3 inch rolled trim style.
- E. Door Material: Clear anodized aluminum.
- F. Door Style: Vertical Duo.
- G. Door Glazing: Acrylic sheet.
  - 1. Acrylic Sheet Color: Clear.
- H. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
- I. Accessories:
  - 1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
  - 2. Lettered Door Handle: One-piece, cast-iron door handle with the word "FIRE" embossed into face.
  - 3. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
  - 4. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed by Architect.
    - a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."
      - 1) Location: Applied to cabinet glazing.
      - 2) Application Process: Decals.
      - 3) Lettering Color: White.
      - 4) Orientation: Vertical.

J. Materials:

1. Aluminum: ASTM B221 for extruded shapes and aluminum sheet, with strength and durability characteristics of not less than Alloy 6063-T5 for aluminum sheet.
  - a. Finish: Clear anodic.
2. Transparent Acrylic Sheet: ASTM D4802, Category A-1 (cell-cast sheet), 3 mm thick, with Finish 1 (smooth or polished).

2.2 FABRICATION

- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Prepare recesses for semi-recessed fire-protection cabinets as required by type and size of cabinet and trim style.
- B. Install fire-protection cabinets in locations indicated and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
- C. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
- D. Identification: Apply decals at specified locations.
- E. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

END OF SECTION 104413

## SECTION 104416 - FIRE EXTINGUISHERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

#### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

#### 1.6 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

## 1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Six years.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

### 2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Amerex Corporation.
    - b. JL Industries (Activar Construction Products)
    - c. Guardian Fire Equipment, Inc.
    - d. Larsens Manufacturing Company.
  - 2. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.
- B. Multipurpose Dry-Chemical Type: UL-rated 4A:80B:C, 10-lbs. nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.

2.3 MOUNTING BRACKETS

- A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or **red** baked-enamel finish.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Amerex Corporation.
    - b. JL Industries (Activar Construction Products)
    - c. Guardian Fire Equipment, Inc.
    - d. Larsens Manufacturing Company.
- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
  - a. Orientation: Vertical.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Examine fire extinguishers for proper charging and tagging.
  1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
  1. Mounting Brackets: Top of fire extinguisher to be at 42 inches above finished floor.
- C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 104416

## SECTION 105113 - METAL LOCKERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Welded corridor lockers.
  - 2. Locker benches.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For metal lockers.
  - 1. Include plans, elevations, sections, and attachment details.
  - 2. Include locker identification system and numbering sequence.
- C. Samples: For each color specified.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Sample warranty.

#### 1.4 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.
  - 1. Warranty Period for Welded Metal Lockers: 10 years Insert years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 WELDED CORRIDOR LOCKERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. ASI Storage Solutions.
  - 2. Olympus Lockers & Storage Products, Inc.
  - 3. Republic Storage Systems, LLC.
- B. Doors: One piece; fabricated from manufacturer's standard thickness, but not less than 0.060-inch nominal-thickness steel sheet; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges.
  - 1. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches wide; welded to inner face of doors.
  - 2. Door Style: Vented panel as follows:
    - a. Louvered Vents: No fewer than six louver openings at top and bottom for single-tier lockers.
- C. Body: Assembled by welding body components together. Fabricate from unperforated steel sheet with thicknesses as follows:
  - 1. Tops, Bottoms, and Sides: 0.060-inch nominal thickness.
  - 2. Backs: 0.048-inch nominal thickness.
  - 3. Shelves: 0.060-inch nominal thickness, with double bend at front and single bend at sides and back.
- D. Frames: Channel formed; fabricated from 0.060-inch nominal-thickness steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral, full-height door strikes on vertical main frames.



- E. Hinges:
  - 1. Hinges: Manufacturer's standard, steel, continuous or knuckle type.
- F. Recessed Door Handle and Latch: Stainless steel cup with integral door pull, recessed so locking device does not protrude beyond door face; pry and vandal resistant.
  - 1. Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks or padlocks; positive automatic latching and prelocking.
    - a. Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism.
- G. Identification Plates: Manufacturer's standard, etched, embossed, or stamped aluminum plates, with numbers and letters at least 3/8 inch high.
- H. Hooks: Manufacturer's standard ball-pointed, aluminum or steel; zinc plated.
- I. Coat Rods: Manufacturer's standard.
- J. Continuous Zee Base: Fabricated from, manufacturer's standard thickness, but not less than 0.060-inch nominal-thickness steel sheet.
  - 1. Height: 4 inches.
- K. Continuous Sloping Tops: Fabricated from 0.048-inch nominal-thickness steel sheet, with a pitch of approximately 20 degrees.
  - 1. Closures: Vertical-end type.
- L. Filler Panels: Fabricated from 0.048-inch nominal-thickness steel sheet.
- M. Finished End Panels: Fabricated from 0.024-inch nominal-thickness steel sheet to cover unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.
- N. 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 A60 zinc-iron, alloy (galvannealed) coating designation.
- O. Finish: Baked enamel or powder coat.
1. Color: As selected by Architect from manufacturer's full range.

## 2.2 LOCKS

- A. Combination Padlock: Provided by Others.

## 2.3 LOCKER BENCHES

- A. Provided by locker manufacturer
- B. Provide bench units with overall assembly height of 17-1/2 inches.
- C. Bench Tops: Manufacturer's standard one-piece units, with rounded corners and edges.
1. Size: Minimum 9-1/2 inches wide by 1-1/4 inches thick.
  2. Laminated clear hardwood with one coat of clear sealer on all surfaces and one coat of clear lacquer on top and sides.
- D. Fixed-Bench Pedestals: Manufacturer's standard supports, with predrilled fastener holes for attaching bench top and anchoring to floor, complete with fasteners and anchors.
1. Color: As selected by Architect from manufacturer's full range.

- E. Materials:
  - 1. Steel Tube: ASTM A500/A500M, cold rolled.

## 2.4 FABRICATION

- A. Fabricate metal lockers square, rigid, without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.
- B. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments.
- C. Equipment: Provide each locker with an identification plate and the following equipment:
  - 1. Single-Tier Units: Shelf, one double-prong ceiling hook, and two single-prong wall hooks.
- D. Welded Construction: Factory preassemble metal lockers by welding all joints, seams, and connections; with no bolts, nuts, screws, or rivets used in assembly of main locker groups. Factory weld main locker groups into one-piece structures. Grind exposed welds smooth and flush.
- E. Continuous Zee Base: Fabricated in lengths as long as practical to enclose base and base ends; finished to match lockers.
- F. Continuous Sloping Tops: Fabricated in lengths as long as practical, without visible fasteners at splice locations; finished to match lockers.
- G. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip-joint filler angle formed to receive filler panel.
- H. Finished End Panels: Fabricated to conceal unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install lockers level, plumb, and true; shim as required, using concealed shims.

1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.
  2. Anchor single rows of metal lockers to walls near top and bottom of lockers.
  3. Anchor back-to-back metal lockers to floor.
- B. Welded Lockers: Connect groups together with manufacturer's standard fasteners, with no exposed fasteners on face frames.
- C. Trim: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.
1. Attach filler panels with concealed fasteners.
  2. Attach sloping-top units to metal lockers, with closures at exposed ends.
  3. Attach finished end panels using fasteners only at perimeter to conceal exposed ends of nonrecessed metal lockers.
- D. Fixed Benches: Provide no fewer than two pedestals for each bench, uniformly spaced.

END OF SECTION 105113

## SECTION 142123.16 - MACHINE ROOM-LESS ELECTRIC TRACTION PASSENGER ELEVATORS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Machine-room-less electric traction elevators.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include Product Data for car enclosures, hoistway entrances, and operation, control, and signal systems.

B. Shop Drawings:

1. Include plans, elevations, sections, and large-scale details indicating service at each landing, coordination with building structure, relationships with other construction, and locations of equipment.
2. Indicate maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.

C. Samples: For each type of exposed finish involving color selection.

#### 1.3 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For elevator equipment, accessories, and components, from manufacturer.

- B. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway and pit layout and dimensions, as indicated on Drawings, and electrical service including standby power generator, as shown and specified, are adequate for elevator system being provided.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.
- B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.
- C. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner, in the form of a standard one-year maintenance agreement, starting on date initial maintenance service is concluded.

#### 1.5 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 1 year from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. KONE Inc.
  - 2. Otis Worldwide Corporation.
  - 3. Schindler Elevator Corp.
  - 4. ThyssenKrupp Elevator.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.
- B. Accessibility Requirements: Comply with requirements for accessible elevators in the United States Access Board's ADA-ABA Accessibility Guidelines and with ICC A117.1.
- C. Seismic Performance: Elevator system to withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7 and comply with elevator seismic requirements in ASME A17.1/CSA B44.
  - 1. Project Seismic Design Category: C.
  - 2. Elevator Component Importance Factor: 1.5.
  - 3. Structural design criteria: see Sht S-001.
  - 4. Provide earthquake equipment required by ASME A17.1/CSA B44.
  - 5. Provide seismic switch required by ASCE/SEI 7.

## 2.3 ELEVATORS

- A. Elevator System, General: Manufacturer's standard elevator systems. Unless otherwise indicated, manufacturer's standard components are to be used, as included in standard elevator systems and as required for complete system.
- B. Elevator Description:
  - 1. Rated Load: 3000 lb.
  - 2. Rated Speed: 150 fpm.
  - 3. Auxiliary Operations:
    - a. Standby power operation.
    - b. Earthquake Emergency Operation: Comply with requirements in ASME A17.1/CSA B44.
  - 4. Car Enclosures:



- a. Inside Width: Not less than 77 inches from side wall to side wall.
  - b. Inside Depth: Not less than 59 inches from back wall to front wall (return panels).
  - c. Inside Height: Not less than 93 inches to underside of ceiling.
  - d. Front Walls (Return Panels): Satin stainless steel, ASTM A480/A480M, No. 4 finish.
  - e. Car Fixtures: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
  - f. Side and Rear Wall Panels: Plastic laminate.
  - g. Reveals: Black.
  - h. Door Faces (Interior): Enameled or powder-coated steel.
  - i. Ceiling: Enameled or powder-coated steel.
  - j. Handrails: 1/2 by 2 inches rectangular satin stainless steel, at rear of car.
  - k. Floor prepared to receive resilient flooring (LVT per Finish Schedule).
5. Hoistway Entrances:
  - a. Width: 42 inches.
  - b. Height: 84 inches.
  - c. Type: Single-speed side sliding.
  - d. Frames: Enameled or powder-coated steel.
  - e. Doors: Enameled or powder-coated steel.
6. Hall Fixtures: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
7. Additional Requirements:
  - a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from satin stainless steel, ASTM A480/A480M, No. 4 finish.
  - b. Provide hooks for protective pads and complete set(s) of full-height protective pads.

2.4 TRACTION SYSTEMS

- A. Elevator Machines: Permanent magnet, variable-voltage, variable-frequency, ac-type hoisting machines and solid-state power converters.
  - 1. Provide nonregenerative system.
- B. Machine Beams: Provide steel framing to support elevator hoisting machine and deflector sheaves from the building structure. Comply with Section 055000 "Metal Fabrications" for materials and fabrication.

2.5 OPERATION SYSTEMS

- A. Provide manufacturer's standard microprocessor operation systems as required to provide type of operation indicated.
  - 1. Provide manufacturer's standard integrated control solution, located in hoistway jamb at top floor stop.
- B. Auxiliary Operations:

1. Single-Car Standby Power Operation: On activation of standby power, car is returned to a designated floor and parked with doors open. Car can be manually put in service on standby power, either for return operation or for regular operation, by switches in control panel located at main lobby. Manual operation causes automatic operation to cease.

## 2.6 DOOR REOPENING DEVICES

- A. Infrared Array: Provide door reopening device with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more light beams cause doors to stop and reopen.
- B. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating door reopening device, a loud buzzer sounds and doors begin to close at reduced kinetic energy.

## 2.7 CAR ENCLOSURES

- A. Provide steel-framed car enclosures with nonremovable wall panels, with car roof, access doors, power door operators, and ventilation.
- B. Materials and Finishes: Manufacturer's standards, but not less than the following:
  - 1. Plastic-Laminate Wall Panels: Plastic laminate adhesively applied to manufacturer's standard honeycomb core with manufacturer's standard protective edge trim. Panels are to have a flame-spread index of 25 or less, when tested in accordance with ASTM E84. Plastic-laminate color, texture, and pattern as selected by Architect from elevator manufacturer's full range.
  - 2. Enameled or Powder-Coated Steel Doors: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel or powder-coat finish; colors as selected by Architect from manufacturer's full range.
  - 3. Sight Guards: Provide sight guards on car doors.
  - 4. Sills: Extruded or machined metal, with grooved surface, 1/4 inch thick.
  - 5. Metallic-Finish, Plastic-Laminate Ceiling: Flush panels, with LED downlights.
  - 6. Light Fixture Efficiency: Not less than 35 lumens/W.
  - 7. Ventilation Fan Efficiency: Not less than 3.0 cfm/W.

## 2.8 HOISTWAY ENTRANCES

- A. Hoistway Entrance Assemblies: Manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Frame size and profile to accommodate hoistway wall construction.

- B. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies comply with NFPA 80 and are to be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction based on testing at as close-to-neutral pressure as possible in accordance to NFPA 252.
  - 1. Fire-Protection Rating: 1 hour.
- C. Materials and Fabrication: Manufacturer's standards, but not less than the following:
  - 1. Enameled or Powder-Coated Steel Frames: Formed from cold- or hot-rolled steel sheet. Provide with factory-applied enamel or powder-coat finish; colors as selected by Architect from manufacturer's full range.
  - 2. Enameled or Powder-Coated Steel Doors: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel or powder-coat finish; colors as selected by Architect from manufacturer's full range.
  - 3. Sight Guards: Provide sight guards on doors matching door edges.
  - 4. Sills: Extruded or machined metal, with grooved surface, 1/4 inch thick.
  - 5. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M.

## 2.9 SIGNAL EQUIPMENT

- A. Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Provide vandal-resistant buttons and lighted elements illuminated with LEDs.
- B. Car-Control Stations: Provide manufacturer's standard recessed car-control stations. Mount in return panel adjacent to car door unless otherwise indicated.
- C. Emergency Communication System: Two-way voice communication system, with visible signal, which dials preprogrammed number of monitoring station and does not require handset use. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.

- D. Car Position Indicator: Provide illuminated, digital-type car position indicator, located above car door or above car-control station. Also, provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served. Include travel direction arrows if not provided in car-control station.
- E. Hall Push-Button Stations: Provide one hall push-button station at each landing.
- F. Hall Lanterns: Units with illuminated arrows; but provide single arrow at terminal landings. Provide[ **one of**] the following:
  - 1. Manufacturer's standard wall-mounted units, for mounting above entrance frames.
- G. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.
- H. Standby Power Elevator Selector Switches: Provide switches, as required by ASME A17.1/CSA B44, where indicated. Adjacent to switches, provide illuminated signal that indicates when normal power supply has failed.
- I. Emergency Pictorial Signs: Fabricate from materials matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire, elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station unless otherwise indicated.

## 2.10 FINISH MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, commercial steel, Type B, exposed, matte finish.
- B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, commercial steel, Type B, pickled.
- C. Stainless Steel Sheet: ASTM A240/A240M, Type 304.
- D. Stainless Steel Bars: ASTM A276/A276M, Type 304.
- E. Stainless Steel Tubing: ASTM A554, Grade MT 304.

- F. Plastic Laminate: High-pressure type complying with ISO 4586-3, Type HGS for flat applications.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.
- B. Lubricate operating parts of systems, including ropes, as recommended by manufacturers.
- C. Leveling Tolerance: 1/8 inch, up or down, regardless of load and travel direction.
- D. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.
- E. Locate hall signal equipment for elevators as follows unless otherwise indicated:
  - 1. Place hall lanterns either above or beside each hoistway entrance.
  - 2. Mount hall lanterns at a minimum of 72 inches above finished floor.

#### 3.2 FIELD QUALITY CONTROL

- A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.

#### 3.3 PROTECTION

- A. Temporary Use: Comply with the following requirements for if elevator used for construction purposes:

1. Provide protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
2. Engage elevator Installer to provide full maintenance service.
3. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate elevator(s).

3.5 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service to include 12 months' full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity.

END OF SECTION 142123.16



## SECTION 210500 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. The Work of this Section includes:

1. Motors.
2. Sleeves without waterstop.
3. Sleeves with waterstop.
4. Stack-sleeve fittings.
5. Sleeve-seal systems.
6. Grout.
7. Silicone sealants.
8. Escutcheons.

#### 1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product, excluding motors which are included in Part 1 of the fire-suppression equipment Sections.
  - a. Include construction details, material descriptions, and dimensions of components.
  - b. Include operating characteristics and furnished accessories.

#### 1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

#### 1.4 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
1. Motor controllers.
  2. Torque, speed, and horsepower requirements of the load.
  3. Ratings and characteristics of supply circuit and required control sequence.
  4. Ambient and environmental conditions of installation location.

## PART 2 - PRODUCTS

### 2.1 MOTORS

#### A. Motor Requirements, General:

1. Content includes motors for use on alternating-current power systems of up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.
2. Comply with requirements in this Section except when stricter requirements are specified in equipment schedules or Sections.
3. Comply with NEMA MG 1 unless otherwise indicated.

#### B. Motor Characteristics:

1. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 ft. above sea level.
2. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

#### C. Polyphase Motors:

1. Description: NEMA MG 1, Design B, medium induction motor.
  2. Efficiency: Premium Efficient, as defined in NEMA MG 1.
  3. Service Factor: 1.15.
  4. Multispeed Motors: Variable torque.
    - a. For motors with 2:1 speed ratio, consequent pole, single winding.
    - b. For motors with other than 2:1 speed ratio, separate winding for each speed.
  5. Multispeed Motors, Multiple Winding: Separate winding for each speed.
  6. Rotor: Random-wound, squirrel cage.
  7. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
  8. Temperature Rise: Match insulation rating.
  9. Insulation: Class F.
  10. Code Letter Designation:
    - a. Motors 15 HP and Larger: NEMA starting Code F or Code G.
    - b. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.
  11. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.
- #### D. Additional Requirements for Polyphase Motors:
1. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

2. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
  - a. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time-rise pulses produced by pulse-width-modulated inverters.
  - b. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
  - c. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
  - d. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

## 2.2 SLEEVES AND SLEEVE SEALS

### A. Sleeves without Waterstop:

1. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron, with plain ends.
2. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, hot-dip galvanized, with plain ends.
3. Steel Sheet Sleeves: ASTM A653/A653M, 24 gauge minimum thickness; hot-dip galvanized, round tube closed with welded longitudinal joint.

### B. Sleeves with Waterstop:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Advance Products & Systems, LLC.
  - b. CALPICO, Inc.
  - c. GPT; a division of EnPRO Industries.
  - d. Metraflex Company (The).
2. Description: Manufactured galvanized steel, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.

### C. Stack-Sleeve Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Jay R. Smith Mfg Co; a division of Morris Group International.
  - b. Wade; a subsidiary of McWane Inc.
  - c. Zurn Industries, LLC.
2. Description: Manufactured, galvanized cast-iron sleeve with integral clamping flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.
  - a. Underdeck Clamp: Clamping ring with setscrews.

### D. Sleeve-Seal Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Advance Products & Systems, LLC.
  - b. CALPICO, Inc.
  - c. GPT; a division of EnPRO Industries.
  - d. Metraflex Company (The).
  - e. Proco Products, Inc.
2. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
  - a. Hydrostatic Seal: 20 psig minimum.
  - b. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.
  - c. Pressure Plates: Stainless steel.
  - d. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

E. Grout:

1. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
2. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
3. Design Mix: 5000 psi, 28-day compressive strength.
4. Packaging: Premixed and factory packaged.

2.3 ESCUTCHEONS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. BrassCraft Manufacturing Co.; a Masco company.
  2. Dearborn Brass.
  3. Jones Stephens Corp.
  4. Keeney Manufacturing Company (The).
  5. Mid-America Fittings, LLC; A Midland Industries Company.
  6. ProFlo; a Ferguson Enterprises, Inc. brand.
- B. Escutcheon Types:
1. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- C. Floor Plates:
1. Split Floor Plates: Steel with concealed hinge.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF PIPE LOOPS AND SWING CONNECTIONS

- A. Install pipe loops and offsets in accordance with NFPA 13 requirements for expansion and contraction compensation.

### 3.2 INSTALLATION OF SLEEVES, GENERAL

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
  - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
  - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
  - 2. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
  - 3. Using grout, seal space outside of sleeves in floors/slabs/walls without sleeve-seal system. Select to maintain fire-resistance of floor/slab/wall.
- D. Install sleeves for pipes passing through interior partitions.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
  - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants that joint sealant manufacturer's literature indicates is appropriate for size, depth, and location of joint.
- E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

### 3.3 INSTALLATION OF SLEEVES WITH WATERSTOP

- A. Install sleeve with waterstop as new walls and slabs are constructed.

- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange centered across width centered in concrete slab or wall.
- C. Secure nailing flanges to wooden concrete forms.
- D. Using grout, seal space around outside of sleeves.

### 3.4 INSTALLATION OF STACK-SLEEVE FITTINGS

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
  - 1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  - 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
  - 3. Install section of cast-iron soil pipe to extend sleeve to 3 inches above finished floor level.
  - 4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  - 5. Using silicone sealant, seal space between top hub of stack-sleeve fitting and pipe.
- B. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe penetrations with fire- or smoke-stop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

### 3.5 INSTALLATION OF SLEEVE-SEAL SYSTEMS

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building, and passing through exterior walls.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

### 3.6 INSTALLATION OF ESCUTCHEONS

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

### 3.7 FIELD QUALITY CONTROL

#### A. Sleeves and Sleeve Seals:

1. Perform the following tests and inspections:
  - a. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
  - b. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.
2. Prepare test and inspection reports.

#### B. Escutcheons:

1. Using new materials, replace broken and damaged escutcheons and floor plates.

### 3.8 SLEEVES APPLICATION

#### A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above and below Grade:
  - a. Sleeves with waterstops.
    - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
2. Concrete Slabs-on-Grade:
  - a. Sleeves with waterstops.
    - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
3. Concrete Slabs above Grade:
  - a. Sleeves with waterstops or stack-sleeve fittings.
4. Interior Walls and Partitions:
  - a. Sleeves without waterstops.

### 3.9 ESCUTCHEONS APPLICATION

#### A. Escutcheons for New Piping:

1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.

2. Chrome-Plated Piping: One piece, cast brass with polished, chrome-plated finish.
3. Insulated Piping:
  - a. One piece, cast brass with polished, chrome-plated finish.
4. Bare Piping at Wall and Floor Penetrations in Finished Spaces:
  - a. One piece, cast brass with polished, chrome-plated finish.
5. Bare Piping at Ceiling Penetrations in Finished Spaces:
  - a. One piece, cast brass with polished, chrome-plated finish.
6. Bare Piping in Unfinished Service Spaces:
  - a. One piece, cast brass with polished, chrome-plated finish.
7. Bare Piping in Equipment Rooms:
  - a. One piece, steel with polished, chrome-plated finish.
  - b. One piece, cast brass with polished, chrome-plated finish.
- B. Install floor plates for piping penetrations of equipment room floors.
- C. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
  1. New Piping: One piece, floor plate.

END OF SECTION 210500



## SECTION 210523 - GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Iron butterfly valves with indicators.
2. Check valves.
3. Iron OS&Y gate valves.
4. Trim and drain valves.

#### 1.2 DEFINITIONS

- A. NRS: Nonrising stem.
- B. OS&Y: Outside screw and yoke.
- C. SBR: Styrene-butadiene rubber.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of valve.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
1. Protect internal parts against rust and corrosion.
  2. Protect threads, flange faces, and weld ends.
  3. Set valves open to minimize exposure of functional surfaces.
- B. Use the following precautions during storage:
1. Maintain valve end protection.

2. Store valves indoors and maintain at higher-than-ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.
- D. Protect flanges and specialties from moisture and dirt.

## PART 2 - PRODUCTS

### 2.1 SOURCE LIMITATIONS

- A. Obtain each type of valve from single manufacturer.

### 2.2 PERFORMANCE REQUIREMENTS

- A. UL Listed: Valves shall be listed in UL's "Online Certifications Directory" under the headings listed below and shall bear UL mark:
  1. Fire Main Equipment: HAMV - Main Level.
    - a. Ball Valves, System Control: HLUG - Level 3.
    - b. Butterfly Valves: HLXS - Level 3.
    - c. Check Valves: HMER - Level 3.
    - d. Gate Valves: HMRZ - Level 3.
  2. Sprinkler System and Water Spray System Devices: VDGT - Main Level.
    - a. Valves, Trim and Drain: VQGU - Level 1.
- B. FM Global Approved: Valves shall be listed in its "Approval Guide," under the headings listed below:

1. Automated Sprinkler Systems:

- a. Indicator posts.
- b. Valves.
  - 1) Gate valves.
  - 2) Check valves.
  - 3) Miscellaneous valves.

C. ASME Compliance:

- 1. ASME B1.20.1 for threads for threaded-end valves.
- 2. ASME B16.1 for flanges on iron valves.
- 3. ASME B31.9 for building services piping valves.

D. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

E. NFPA Compliance for Valves:

- 1. Comply with NFPA 13, NFPA 14, NFPA 20, and NFPA 24.

F. Valve Pressure Ratings: Not less than the minimum pressure rating indicated or higher, as required by system pressures.

G. Valve Sizes: Same as upstream piping unless otherwise indicated.

H. Valve Actuator Types:

- 1. Worm-gear actuator with handwheel for quarter-turn valves, except for trim and drain valves.
- 2. Handwheel: For other than quarter-turn trim and drain valves.
- 3. Handlever: For quarter-turn trim and drain valves NPS 2 and smaller.

2.3 IRON BUTTERFLY VALVES WITH INDICATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1. Anvil; an ASC Engineered Solution.
- 2. Kennedy Valve Company; a division of McWane, Inc.
- 3. NIBCO INC.
- 4. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
- 5. Victaulic Company.
- 6. Zurn Industries, LLC.

B. Description:

1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 112.
2. Minimum Pressure Rating: 175 psig.
3. Body Material: Cast or ductile iron with nylon, EPDM, epoxy, or polyamide coating.
4. Seat Material: EPDM.
5. Stem: Stainless steel.
6. Disc: Ductile iron, nickel plated and EPDM or SBR coated.
7. Actuator: Worm gear.
8. Supervisory Switch: Internal or external.
9. Body Design: Lug or wafer Grooved-end connections.

2.4 CHECK VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Anvil; an ASC Engineered Solution.
2. Kennedy Valve Company; a division of McWane, Inc.
3. NIBCO INC.
4. Victaulic Company.
5. Viking Group Inc.
6. WATTS; A Watts Water Technologies Company.
7. Zurn Industries, LLC.

B. Description:

1. Standard: UL 312 and FM Global standard for swing check valves, Class Number 1210.
2. Minimum Pressure Rating: 175 psig.
3. Type: Single swing check.
4. Body Material: Cast iron, ductile iron, or bronze.
5. Clapper: Bronze, ductile iron, or stainless steel with elastomeric seal.
6. Clapper Seat: Brass, bronze, or stainless steel.
7. Hinge Shaft: Bronze or stainless steel.
8. Hinge Spring: Stainless steel.
9. End Connections: Flanged, grooved, or threaded.

## 2.5 IRON OS&Y GATE VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Clow Valve Company; a subsidiary of McWane, Inc.
2. Kennedy Valve Company; a division of McWane, Inc.
3. Mueller Co. LLC; Mueller Water Products, Inc.
4. NIBCO INC.
5. Victaulic Company.
6. WATTS; A Watts Water Technologies Company.
7. Zurn Industries, LLC.

B. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig.
3. Body and Bonnet Material: Cast or ductile iron.
4. Wedge: Cast or ductile iron, or bronze with elastomeric coating.
5. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
6. Stem: Brass or bronze.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.
9. End Connections: Flanged, Grooved.

## 2.6 TRIM AND DRAIN VALVES

A. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
- b. Croker; a Division of Morris Group International.
- c. Milwaukee Valve Company.
- d. NIBCO INC.
- e. Potter Roemer LLC; a Division of Morris Group International.
- f. Red-White Valve Corp.
- g. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
- h. Victaulic Company.
- i. WATTS; A Watts Water Technologies Company.
- j. Zurn Industries, LLC.

2. Description:

- a. Pressure Rating: 300 psig.
- b. Body Design: Two piece.

- c. Body Material: Forged brass or bronze.
- d. Port size: Full or standard.
- e. Seats: PTFE.
- f. Stem: Bronze or stainless steel.
- g. Ball: Chrome-plated brass.
- h. Actuator: Handlever.
- i. End Connections for Valves NPS 1 through NPS 2-1/2: Threaded ends.
- j. End Connections for Valves NPS 1-1/4 and NPS 2-1/2: Grooved ends.

B. Angle Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Fire Protection Products Inc (FPPI); a brand of Anvil International and Smith-Cooper International.
  - b. NIBCO INC.
  - c. United Brass Works, Inc.
2. Description:
  - a. Pressure Rating: 300 psig.
  - b. Body Material: Brass or bronze.
  - c. Ends: Threaded.
  - d. Stem: Bronze.
  - e. Disc: Bronze.
  - f. Packing: Asbestos free.
  - g. Handwheel: Malleable iron, bronze, or aluminum.

C. Globe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. NIBCO INC.
  - b. United Brass Works, Inc.

2. Description:

- a. Pressure Rating: 300 psig.
- b. Body Material: Bronze with integral seat and screw-in bonnet.
- c. Ends: Threaded.
- d. Stem: Bronze.
- e. Disc Holder and Nut: Bronze.
- f. Disc Seat: Nitrile.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron, bronze, or aluminum.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION, GENERAL

- A. Comply with requirements in the following Sections for specific valve-installation requirements and applications:
  - 1. Section 211000 "Water-Based Fire-Suppression Systems" for application of valves in fire-suppression standpipes; wet-pipe, fire-suppression sprinkler systems; and dry-pipe, fire-suppression sprinkler systems.
- B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply, except from fire-department connections. Install permanent identification signs, indicating portion of system controlled by each valve.
- C. Install double-check valve assembly in each fire-protection water-supply connection.
- D. Install valves having threaded connections with unions at each piece of equipment arranged to allow easy access, service, maintenance, and equipment removal without system shutdown. Provide separate support where necessary.

- E. Install valves in horizontal piping with stem at or above the pipe center.
- F. Install valves in position to allow full stem movement.
- G. Install valve tags. Comply with requirements in Section 210553 "Identification for Fire-Suppression Piping and Equipment" for valve tags and schedules and signs on surfaces concealing valves; and the NFPA standard applying to the piping system in which valves are installed. Install permanent identification signs indicating the portion of system controlled by each valve.

END OF SECTION 210523



SECTION 210529 - HANGERS AND SUPPORTS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Fastener systems.
4. Equipment supports.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 210516 "Expansion Fittings and Loops for Fire-Suppression Piping" for pipe guides and anchors.
3. Section 210548.13 "Vibration Controls for Fire-Suppression Piping and Equipment" for vibration isolation devices.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
  - 1. Trapeze pipe hangers.
  - 2. Metal framing systems.
  - 3. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 1. Detail fabrication and assembly of trapeze hangers.
  - 2. Include design calculations for designing trapeze hangers.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

#### 1.5 QUALITY ASSURANCE

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.
- B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.
- B. Structural Performance: Hangers and supports for fire-suppression piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
  - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
  - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. NFPA Compliance: Comply with NFPA 13.
- D. UL Compliance: Comply with UL 203.

## 2.2 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
  - 1. Description: Factory-fabricated components, NFPA approved, UL listed, or FM approved for fire-suppression piping support.
  - 2. Galvanized Metallic Coatings: Pregalvanized or hot-dip galvanized.
  - 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

## 2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with NFPA-approved, UL-listed, or FM-approved carbon-steel hanger rods, nuts, saddles, and U-bolts.

## 2.4 EQUIPMENT SUPPORTS

- A. Description: NFPA-approved, UL-listed, or FM-approved, welded, shop- or field-fabricated equipment support, made from structural-carbon-steel shapes.

## 2.5 MATERIALS

- A. Aluminum: ASTM B221.
- B. Carbon Steel: ASTM A1011/A1011M.

- C. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; black and galvanized.
- D. Stainless Steel: ASTM A240/A240M.
- E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout, suitable for interior and exterior applications.
  - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.

### PART 3 - EXECUTION

#### 3.1 APPLICATION

- A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

#### 3.2 INSTALLATION OF HANGERS AND SUPPORTS

- A. Metal Pipe-Hanger Installation: Comply with installation requirements of approvals and listings. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
  - 2. Field fabricate from ASTM A36/A36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete, after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Install in accordance with approvals and listings.
  2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions. Install in accordance with approvals and listings.
- E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- G. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- H. Install lateral bracing with pipe hangers and supports to prevent swaying.
- I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms, and install reinforcing bars through openings at top of inserts.
- J. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

### 3.3 INSTALLATION OF EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment, and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### 3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

### 3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

### 3.6 PAINTING

- A. Touchup:
  - 1. Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
    - a. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

### 3.7 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with NFPA requirements for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.

- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers, and metal framing systems and attachments for general service applications.
- F. Use stainless-steel pipe hangers and stainless-steel attachments for hostile environment applications.
- G. Horizontal-Piping Hangers and Supports: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
  - 2. Steel Pipe Clamps (MSS Type 4): For suspension of NPS 1/2 to NPS 24 if little or no insulation is required.
  - 3. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  - 4. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
  - 5. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
  - 6. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
  - 7. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
  - 8. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
  - 9. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
- H. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
  - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- I. Hanger-Rod Attachments: Comply with NFPA requirements.
- J. Building Attachments: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  - 2. C-Clamps (MSS Type 23): For structural shapes.
  - 3. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.

- K. Saddles and Shields: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  - 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  - 3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.
- L. Comply with NFPA requirements for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

END OF SECTION 210529



SECTION 210548 - VIBRATION AND SEISMIC CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Elastomeric hangers.
5. Snubbers.
6. Restraints - rigid type.
7. Restraints - cable type.
8. Restraint accessories.
9. Post-installed concrete anchors.
10. Concrete inserts.

B. Related Requirements:

1. Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for devices for plumbing equipment and systems.
2. Section 230548 "Vibration and Seismic Controls for HVAC" for devices for HVAC equipment and systems.

1.2 DEFINITIONS

Retain terms that remain after this Section has been edited for a project.

- A. Designated Seismic System: A fire-suppression component that requires design in accordance with ASCE/SEI 7, Ch. 13 and for which the Component Importance Factor is greater than 1.0.
- B. IBC: International Building Code.
- C. OSHPD: Office of Statewide Health Planning and Development (for the State of California).

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.

Retain first subparagraph below if wind-load design services have been delegated to Contractor.

2. Include load rating for each wind-load-restraint fitting and assembly.

3. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component.

See the Evaluations for a discussion on seismic-restraint capacities and rating services. Retain all options in first subparagraph below that apply.

4. Annotate types and sizes of seismic restraints and accessories, complete with listing markings or report numbers and load rating in tension and compression as evaluated by UL product listing.
5. Annotate to indicate application of each product submitted and compliance with requirements.
6. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Shop Drawings:

1. Detail fabrication and assembly of equipment bases.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

Retain "Delegated Design Submittal" Paragraph below if design services have been delegated to Contractor.

C. Delegated Design Submittal:

1. For each seismic-restraint device, including seismic-restrained mounting, pipe-riser resilient support, snubber, seismic restraint, seismic-restraint accessory, and concrete anchor and insert that is required by this Section or is indicated on Drawings, submit the following:
  - a. Seismic- and Wind-Load- Restraint Selection: Select seismicrestraints complying with performance requirements, design criteria, and analysis data.
  - b. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, and seismic loads. Include certification by professional engineer that riser system was examined for excessive stress and that none exists.
  - c. Post-Installed Concrete Anchors and Inserts: Include calculations showing anticipated seismic loads. Include certification that device is approved by an NRTL for seismic reinforcement use.

Retain "Seismic Design Calculations" Subparagraph below if seismic design services have been delegated to Contractor.

- d. Seismic Design Calculations: Submit all input data and loading calculations prepared under "Seismic Design Calculations" Paragraph in "Performance Requirements" Article.
- e. Qualified Professional Engineer: All designated-design submittals for seismiccalculations are to be signed and sealed by qualified professional engineer responsible for their preparation.

Retain first subparagraph below only if design requirements apply but calculations have not been made and details or charts on Drawings do not describe seismic or wind restraints in detail. Retaining below

requires Contractor to submit seismic-restraint delegated design Drawings prepared by a professional engineer. Revise to suit Project requirements.

2. Seismic- Restraint Detail Drawing:

- a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
- b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.

Retain first subparagraph below if Project includes equipment mounted outdoors or otherwise subject to wind loading.

- c. Coordinate seismic restraint details with wind-load restraint details required for equipment mounted outdoors. Comply also with requirements in other Sections for equipment mounted outdoors.
3. Product Listing, Preapproval, and Evaluation Documentation: By UL, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
  4. All delegated design submittals for seismic-restraint detail Drawings are to be signed and sealed by qualified professional engineer responsible for their preparation.
- D. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, and seismic loads. Include certification that riser system was examined for excessive stress and that none exists.

1.4 INFORMATIONAL SUBMITTALS

Retain "Coordination Drawings" Paragraph below for situations where limited space necessitates maximum utilization for efficient installation of different components or if coordination is required for installation of products and materials by separate installers. Coordinate paragraph with other Sections specifying products listed below. Preparation of coordination drawings requires the participation of each trade involved in installations within the limited space.

- A. Coordination Drawings: Show coordination of seismic bracing for fire-suppression piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

Coordinate "Qualification Data" Paragraph below with qualification requirements in Section 014000 "Quality Requirements" and as may be supplemented in "Quality Assurance" Article.

- B. Qualification Data: For professional engineer and testing agency.

Retain "Welding certificates" Paragraph below if retaining "Welding Qualifications" Paragraph in "Quality Assurance" Article.

- C. Welding certificates.

Retain "Field quality-control reports" Paragraph below if Contractor is responsible for field quality-control testing and inspecting.

- D. Field quality-control reports.

Retain "Seismic Qualification Data" Paragraph below in "Informational Submittals" Article of all Specification Sections that specify Designated Seismic Systems, or as required by authorities having jurisdiction.

See "Special Certification" Article in the Evaluations for a discussion on certification and see Paragraph 13.2.2 of ASCE/SEI 7-05, ASCE/SEI 7-10, or ASCE/SEI 7-16 for specific requirements. Fire-suppression system engineer must identify all equipment and systems required to have special certification. These must be identified in Equipment Schedule or separate Vibration Isolation, Seismic, and Wind-Load-Restraints Schedule; or, if the number of devices and systems is small, they can be listed in the Specifications.

- E. Seismic Qualification Data: Provide special certification for designated seismic systems as indicated in ASCE/SEI 7-16, Paragraph 13.2.2, "Special Certification Requirements for Designated Seismic Systems" for all Designated Seismic Systems identified as such on Drawings or in the Specifications.
1. Provide equipment manufacturer's written certification for each designated active fire-suppression system seismic device and system, stating that it will remain operable following the design earthquake. Certification must be based on requirements of ASCE/SEI 7 and AHRI 1270, including shake table testing per ICC-ES AC156 or a similar nationally recognized testing standard procedure acceptable to authorities having jurisdiction ASCE/SEI 7-16.
  2. Provide equipment manufacturer's written certification that components with hazardous contents maintain containment following the design earthquake by methods required in ASCE/SEI 7-16.
  3. Submit evidence demonstrating compliance with these requirements for approval to authorities having jurisdiction after review and acceptance by a licensed professional engineer.

Retain "Wind-Load Performance Certification" Paragraph below in "Informational Submittals" Article of all Specification Sections that specify fire-suppression system equipment requiring wind-load certification.

## 1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Seismic-Restraint Device Load Ratings: Devices to be tested and rated in accordance with applicable code requirements and authorities having jurisdiction. Devices to be listed by a nationally recognized third party that requires periodic follow-up inspections and has a listing

directory available to the public. Provide third-party listing by one or more of the following: UL product listing.

## PART 2 - PRODUCTS

Manufacturers and products listed in this Section are neither recommended nor endorsed by the AIA or Deltek. Before selecting manufacturers and products, verify availability, suitability for intended applications, and compliance with minimum performance requirements. Product options commonly available from manufacturers are included in square brackets throughout the Section Text. Not every manufacturer listed can provide every option offered; verify availability with manufacturers. For definitions of terms and requirements for Contractor's product selection, see Section 016000 "Product Requirements."

See the Evaluations for more detailed information about controlling vibration, additional information on products described in this Section, illustrations, selection guides, and supplements to Equipment Schedules.

Coordinate specifications for products in this Section with Project structural engineer and with Drawings.

### 2.1 PERFORMANCE REQUIREMENTS

Retain "Delegated Design" Paragraph below if Contractor is required to assume responsibility for design.

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design seismic control system.

Retain "Seismic Performance" Subparagraph below for projects requiring seismic design. Delete subparagraph if performance requirements are indicated on Drawings. Model building codes and ASCE/SEI 7 establish criteria for buildings subject to earthquake motions. Coordinate requirements with structural engineer.

- 1. Seismic Performance: Equipment must be designed and secured to withstand the effects of earthquake motions determined in accordance with NFPA 13 and ASCE/SEI 7-16.

- B. Seismic Design Calculations:

NFPA 13 and ASCE/SEI 7 are generally applicable in most locations, but it is fire-suppression system engineer's responsibility to determine the applicable building codes and editions thereof, and applicable seismic design standards that apply to Project. Data and information required for seismic calculations in NFPA 13 and ASCE/SEI 7 are listed below. ASCE/SEI 7-05, ASCE/SEI 7-10, and ASCE/SEI 7-16 differ somewhat; criteria from all three editions have been included below and have been noted. Fire-suppression system engineer must delete all non-applicable edition references throughout this Section.

If a calculation method other than that prescribed in any edition of ASCE/SEI 7 is applicable to Project, fire-suppression system engineer must revise the Section Text to provide alternative appropriate calculation parameters and instructions for delegated designer in lieu of those given below.

- 1. Perform calculations to obtain force information necessary to properly select seismic-restraint devices, fasteners, and anchorage. Perform calculations using methods

acceptable to applicable code authorities and as presented in NFPA 13 and ASCE/SEI 7-16. Where "ASCE/SEI 7" is used throughout this Section, it is to be understood that the edition referred to in this subparagraph is the edition intended as reference throughout the Section Text.

- a. Data indicated below to be determined by Delegated Design Contractor must be obtained by Contractor and must be included in individual component submittal packages.

Data values identified below as applying to all components on Project are to be inserted by fire-suppression system engineer in these Specifications where indicated in the following list. Data values that are specific to an individual generic component and are indicated to be scheduled should be included by fire-suppression system engineer in Fire-Suppression System Vibration Isolation, and Seismic Load Restraints Schedule or the individual component schedules on Drawings. Data values that are specific to an individual piece of equipment as provided by Contractor and are indicated to be obtained by Contractor must be included in individual component submittal packages.

The term "Building Risk Category" is used in ASCE/SEI 7-10 and ASCE/SEI 7-16. Fire-suppression system engineer must obtain the value from Project structural engineer and retain first subparagraph below.

- b. Building Risk Category: IV.

Fire-suppression system engineer must obtain "Building Site Classification" value from Project structural engineer and retain first subparagraph below.

- c. Building Site Classification: D.

Retain "Calculation Factors, ASCE/SEI 7-16, Ch. 13 - Seismic Design Requirements for Nonstructural Components" Subparagraph below if ASCE/SEI 7-16 applies to this Project.

2. Calculation Factors, ASCE/SEI 7-16, Ch. 13 - Seismic Design Requirements for Nonstructural Components: All section, paragraph, equation, and table numbers refer to ASCE/SEI 7-16 unless otherwise noted.
  - a. Horizontal Seismic Design Force  $F_p$ : Value is to be calculated by Delegated Design Contractor using Equation 13.3-1. Factors below must be obtained for this calculation:

"Spectral Acceleration" value applies to all components on Project. Value is to be obtained by fire-suppression system engineer from Project structural engineer based on ASCE/SEI 7-16 Section 11.4.5.

- 1)  $S_{DS}$  = Spectral Acceleration: 0.296. Value applies to all components on Project.

"Component Amplification Factor" for each component is selected by fire-suppression system engineer as explained in ASCE/SEI 7-16 Section 13.6.1. List on Drawing Schedule for each component.

- 2)  $a_p$  = Component Amplification Factor: See Drawing Schedule for each component.

"Component Importance Factor" is assigned by fire-suppression system engineer as explained in ASCE/SEI 7-16 Section 13.1.3. List on Drawing Schedule for each component.

- 3)  $I_p$  = Component Importance Factor: See Drawing Schedule for each component.
- 4)  $W_p$  = Component Operating Weight: For each component. Obtain by Delegated Design Contractor from each component submittal.

"Component Response Modification Factor" is selected by fire-suppression system engineer from ASCE/SEI 7-16, Table 13.6-1. List on Drawing Schedule for each component.

- 5)  $R_p$  = Component Response Modification Factor: See Drawing Schedule for each component.
  - 6)  $z$  = Height in Structure of Point of Attachment of Component for Base: Determine from Project Drawings for each component by Delegated Design Contractor. For items at or below the base, "z" is to be taken as zero.
  - 7)  $h$  = Average Roof Height of Structure for Base: Determine from Project Drawings by Delegated Design Contractor.
- b. Vertical Seismic Design Force: Calculated by Delegated Design Contractor using method explained in ASCE/SEI 7-16, Paragraph 13.3.1.2.
- c. Seismic Relative Displacement  $D_p$ : Calculated by Delegated Design Contractor using methods explained in ASCE/SEI 7-16, Paragraph 13.3.2. Factors below must be obtained for this calculation:
- 1)  $D_p$  = Relative Seismic Displacement that Each Component Must Be Designed to Accommodate: Calculated by Delegated Design Contractor in accordance with ASCE/SEI 7-16, Paragraph 13.3.2.

"Structure Importance Factor" is assigned by fire-suppression system engineer from Project structural engineer and ASCE/SEI 7-16 Section 11.5.1.

- 2)  $I_e$  = Structure Importance Factor: 1.5. Value applies to all components on Project.

"Deflection at building level x of Structure A" value is determined for each component in building in accordance with ASCE/SEI 7-16, Equation 12.8-15 and depends upon location of component in the building. Value is obtained by fire-suppression system engineer from Project structural engineer.

- 3)  $\delta_{xA}$  = Deflection at Building Level x of Structure A: See Drawing Schedule for each component.

"Deflection at building level y of Structure A" value is determined for each component in building in accordance with ASCE/SEI 7-16, Equation 12.8-15 and depends upon location of component in the building. Value is obtained by fire-suppression system engineer from Project structural engineer.

- 4)  $\delta_{yA}$  = Deflection at Building Level y of Structure A: See Drawing Schedule for each component.

"Deflection at building level y of Structure B" value is determined for each component in building in accordance with ASCE/SEI 7-16, Equation 12.8-15 and depends upon location of component in the building. Value is obtained by fire-suppression system engineer from Project structural engineer.

- 5)  $\delta_{yB}$  = Deflection at Building Level y of Structure B: See Drawing Schedule for each component.
- 6)  $h_x$  = Height of Level x to which Upper Connection Point Is Attached: Determine for each component by Delegated Design Contractor from Project Drawings and manufacturer's data.

- 7)  $h_y$  = Height of Level y to which Upper Connection Point Is Attached: Determine for each component by Delegated Design Contractor from Project Drawings and manufacturer's data.

"Allowable story drift for Structure A" value is determined in accordance with ASCE/SEI 7-16, Equation 12.12-1 and depends upon location of component in the building. Value is obtained by fire-suppression system engineer from Project structural engineer.

- 8)  $\Delta_{aA}$  = Allowable Story Drift for Structure A: See Drawing Schedules for each component.

"Allowable story drift for Structure B" value is determined in accordance with ASCE/SEI 7-16, Equation 12.12-1 and depends upon location of component in the building. Value is obtained by fire-suppression system engineer from Project structural engineer.

- 9)  $\Delta_{aB}$  = Allowable Story Drift for Structure B: See Drawing Schedules for each component.

"Story Height" used in the definition of the "allowable drift" value is determined in accordance with ASCE/SEI 7-16, Table 12.12-1 and depends upon location of component in the building. Value is obtained by fire-suppression system engineer from Project structural engineer.

- 10)  $h_{sx}$  = Story Height Used in the Definition of the Allowable Drift  $\Delta_a$ : See Drawings Schedules for each component.

- d. Component Fundamental Period  $T_p$ : Calculated by Delegated Design Contractor using methods explained in ASCE/SEI 7-16, Paragraph 13.3.3. Factors below must be obtained for this calculation:

- 1)  $W_p$  = Component Operating Weight: Determined by contractor from Project Drawings and manufacturer's data.
- 2)  $g$  = Gravitational Acceleration: 32.17 fps<sup>2</sup>.
- 3)  $K_p$  = Combined Stiffness of Component, Supports, and Attachments: Determined by delegated design seismic engineer.

Retain "Calculation Factors, ASCE/SEI 7-10, Ch. 13 - Seismic Design Requirements for Nonstructural Components" Subparagraph below if ASCE/SEI 7-10 applies to this Project.

Retain "Calculation Factors, ASCE/SEI 7-05, Ch. 13 - Seismic Design Requirements for Nonstructural Components" Subparagraph below if ASCE/SEI 7-05 applies to this Project.

Retain "Wind-Load Design Calculations" Paragraph and applicable calculation factors subparagraph below if wind-load reinforcement design services have been delegated to Contractor.

- C. Consequential Damage: Provide additional seismic and wind-load restraints for suspended fire-suppression system components or anchorage of floor-, roof-, or wall-mounted fire-suppression system components as indicated in ASCE/SEI 7-16 so that failure of a non-essential or essential fire-suppression system component will not cause the failure of any other essential architectural, mechanical, or electrical building component.
- D. Fire/Smoke Resistance: Seismic-restraint devices that are not constructed of ferrous metals must have a maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested by an NRTL in accordance with ASTM E84 or UL 723, and be so labeled.



E. Component Supports:

1. Load ratings, features, and applications of all reinforcement components must be based on testing standards of a nationally recognized testing agency.
2. All component support attachments must comply with force and displacement resistance requirements of ASCE/SEI 7-16 Section 13.6.

2.2 ELASTOMERIC ISOLATION PADS

Copy "Elastomeric Isolation Pads" Paragraph below and re-edit for each product.

Configuration and materials of elastomeric isolation pads depend on the equipment being supported. It is possible to have more than one type of elastomeric isolation pad on same Project. Insert Drawing designation. Use these designations on Drawings to identify each product.

A. Elastomeric Isolation Pads: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. CADDY; brand of nVent Electrical plc.
  - b. California Dynamics Corporation.
  - c. Kinetics Noise Control, Inc.
  - d. Mason Industries, Inc.
  - e. VMC GROUP.
2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
3. Size: Factory or field cut to match requirements of supported equipment.
4. Pad Material: Oil and water resistant with elastomeric properties. Neoprene rubber, silicone rubber, or other elastomeric material.
5. Surface Pattern: Smooth, ribbed, or waffle pattern.

Retain first subparagraph below if pad is infused with synthetic fibers.

6. Infused nonwoven cotton or synthetic fibers.

Retain first subparagraph below if galvanized-steel baseplates are adhered to isolation pad to facilitate load distribution.

7. Load-bearing metal plates adhered to pads.

Retain "Sandwich-Core Material" Subparagraph below if pad has a sandwich-core material.

Copy below and re-edit for each sandwich-core material. Core materials may not be elastomeric. See "Elastomeric Isolation Pads" Article in the Evaluations for more information.

8. Sandwich-Core Material: Resilient and elastomeric.

Retain "Surface Pattern" Subparagraph below if the sandwich-core material has a surface pattern.

- a. Surface Pattern: Smooth, ribbed, or waffle pattern.

Retain subparagraph below if pad is infused with synthetic fibers.

- b. Infused nonwoven cotton or synthetic fibers.

## 2.3 ELASTOMERIC ISOLATION MOUNTS

Copy "Double-Deflection, Elastomeric Isolation Mounts" Paragraph below and re-edit for each product.

Configuration and materials of elastomeric isolation mounts depend on the equipment being supported. It is possible to have more than one type of elastomeric isolation mount on same Project. Insert drawing designation. Use these designations on Drawings to identify each product.

### A. Double-Deflection, Elastomeric Isolation Mounts: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. CADDY; brand of nVent Electrical plc.
  - b. California Dynamics Corporation.
  - c. Kinetics Noise Control, Inc.
  - d. Mason Industries, Inc.
  - e. VMC GROUP.
2. Mounting Plates:
  - a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.

Retain "Baseplate" Subparagraph below if the elastomeric mount being specified has a baseplate.

- b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
3. Elastomeric Material: Molded, oil- and water-resistant neoprene rubber, silicone rubber, or other elastomeric material.

## 2.4 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

Copy "Restrained Elastomeric Isolation Mounts" Paragraph below and re-edit for each product.

Configuration and materials of restrained elastomeric isolation mounts depend on the equipment being supported. It is possible to have more than one type of restrained elastomeric isolation mount on same Project. Insert drawing designation. Use these designations on Drawings to identify each product.

### A. Restrained Elastomeric Isolation Mounts: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. CADDY; brand of nVent Electrical plc.
  - b. California Dynamics Corporation.

- c. [Kinetics Noise Control, Inc.](#)
  - d. [Mason Industries, Inc.](#)
  - e. [VMC GROUP.](#)
2. Description: All-directional isolator with seismic restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
  - a. Housing: Cast-ductile iron or welded steel.
  - b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

## 2.5 ELASTOMERIC HANGERS

Copy "Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods" Paragraph below and re-edit for each product.

Configuration and materials of elastomeric hangers depend on the equipment being supported. It is possible to have more than one type of elastomeric hanger on same Project. Insert drawing designation. Use these designations on Drawings to identify each product.

### A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. [CADDY; brand of nVent Electrical plc.](#)
  - b. [California Dynamics Corporation.](#)
  - c. [Kinetics Noise Control, Inc.](#)
  - d. [Mason Industries, Inc.](#)
  - e. [VMC GROUP.](#)
2. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
3. Damping Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel-to-steel contact.

## 2.6 SNUBBERS

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. [CADDY; brand of nVent Electrical plc.](#)
  - b. [California Dynamics Corporation.](#)
  - c. [Kinetics Noise Control, Inc.](#)
  - d. [Mason Industries, Inc.](#)
  - e. [VMC GROUP.](#)
- B. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Post-Installed Concrete Anchor Bolts: Secure to concrete surface with post-installed concrete anchors. Anchors to be seismically prequalified in accordance with ACI 355.2 testing and designated in accordance with ACI 318-14 Ch. 17 for 2015 or 2018 IBC.
2. Preset Concrete Inserts: Seismically prequalified in accordance with ICC-ES AC446 testing.
3. Anchors in Masonry: Design in accordance with TMS 402.
4. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
5. Resilient Cushion: Maximum 1/4-inch air gap, and minimum 1/4 inch thick.

## 2.7 RESTRAINTS - RIGID TYPE

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. CADDY; brand of nVent Electrical plc.
  - b. California Dynamics Corporation.
  - c. Kinetics Noise Control, Inc.
  - d. Mason Industries, Inc.
  - e. VMC GROUP.
- B. Description: Shop- or field-fabricated bracing assembly made of AISI S110-07-S1 slotted steel channels, ANSI/ASTM A53/A53M steel pipe as per NFPA 13, or other rigid steel brace member. Includes accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

## 2.8 RESTRAINTS - CABLE TYPE

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. CADDY; brand of nVent Electrical plc.
  - b. California Dynamics Corporation.
  - c. Kinetics Noise Control, Inc.
  - d. Mason Industries, Inc.
  - e. VMC GROUP.
- B. Seismic-Restraint Cables: ASTM A1023/A12023M galvanized or ASTM A603 galvanized-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for seismic restraining cable service; with fittings attached by means of poured socket, swaged socket or mechanical (Flemish eye) loop.
- C. Restraint cable assembly with cable fittings must comply with ASCE/SEI 19. All cable fittings and complete cable assembly must maintain the minimum cable breaking force. U-shaped cable clips and wedge-type end fittings do not comply and are unacceptable.

## 2.9 RESTRAINT ACCESSORIES

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. CADDY; brand of nVent Electrical plc.
  - b. California Dynamics Corporation.
  - c. Kinetics Noise Control, Inc.
  - d. Mason Industries, Inc.
  - e. VMC GROUP.

Retain "Hanger-Rod Stiffener" Paragraph below for strengthening resistance of hanger rods against seismic and wind forces that may cause buckling of rods; delete if detailed on Drawings. Use with either rigid- or cable-type bracing assemblies when required to counter seismic and wind forces. Detail fabrication and indicate locations on Drawings.

- B. Hanger-Rod Stiffener: Reinforcing steel angle clamped to hanger rod. Non-metallic stiffeners are unacceptable.
- C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid restraints and restraint cables.
- D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
- E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.
- F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

## 2.10 POST-INSTALLED CONCRETE ANCHORS

### A. Mechanical Anchor Bolts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Atkore Unistrut.
  - b. Cooper B-line; brand of Eaton, Electrical Sector.
  - c. Hilti, Inc.
  - d. Mason Industries, Inc.
  - e. Powers Fasteners.
2. Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength for anchor and as tested according to ASTM E488/E488M.

B. Adhesive Anchor Bolts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Atkore Unistrut.
    - b. Cooper B-line; brand of Eaton, Electrical Sector.
    - c. Hilti, Inc.
    - d. Mason Industries, Inc.
    - e. Powers Fasteners.
  2. Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488/E488M.
- C. Provide post-installed concrete anchors that have been prequalified for use in seismic applications. Post-installed concrete anchors must comply with all requirements of ASCE/SEI 7-16, Ch. 13.
1. Prequalify post-installed anchors in concrete in accordance with ACI 355.2 or other approved qualification testing procedures.
  2. Prequalify post-installed anchors in masonry in accordance with approved qualification procedures.

Retain paragraph below if ASCE/SEI 7-05 applies.

- D. Expansion-type anchor bolts are not permitted for equipment in excess of 10 hp that is not vibration isolated.
1. Undercut expansion anchors are permitted.

2.11 CONCRETE INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Atkore Unistrut.
  2. Cooper B-line; brand of Eaton, Electrical Sector.
  3. Hilti, Inc.
  4. Mason Industries, Inc.
  5. Powers Fasteners.
- B. Provide preset concrete inserts that are seismically prequalified in accordance with ICC-ES AC466 testing.
- C. Comply with ANSI/MSS SP-58.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger-Rod Stiffeners: Install where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry calculated static and seismic loads within specified loading limits.

### 3.3 INSTALLATION OF VIBRATION CONTROL, WIND-LOAD-RESTRAINT, AND SEISMIC-RESTRAINT DEVICES

- A. Provide vibration-control devices for systems and equipment where indicated in Equipment Schedules or Fire-Suppression Vibration Isolation, Seismic, and Wind-Load-Restraint Schedule, where indicated on Drawings, or where the Specifications indicate they are to be installed on specific equipment and systems.
- B. Provide seismic-restraint devices for systems and equipment where indicated in Equipment Schedules or Vibration Isolation, Seismic, and Wind-Load-Restraint Schedules, where indicated on Drawings, where the Specifications indicate they are to be installed on specific equipment and systems, and where required by applicable codes.
- C. Coordinate location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."
- D. Installation of vibration isolators and seismic restraints must not cause any stresses, misalignment, or change of position of equipment or piping.
- E. Comply with installation requirements of NFPA 13 for installation of all seismic-restraint devices.

F. Comply with requirements in Section 077200 "Roof Accessories" for installation of equipment supports and roof penetrations.

G. Equipment Restraints:

Indicate type and quantity of snubbers, wind-load restraint, and seismic-restraint devices described in three subparagraphs below, on Drawings, or in Fire-Suppression Vibration Isolation, Seismic, and Wind-Load-Restraint Schedule on Drawings.

1. Install snubbers on fire-suppression equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.

H. Piping Restraints:

1. Comply with all requirements in NFPA 13.
2. Design piping sway bracing in accordance with NFPA 13.
  - a. Maximum spacing of all sway bracing to be no greater than indicated in NFPA 13.
  - b. Design loading of all sway bracing not to exceed values indicated in NFPA 13.

I. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.

J. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

K. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

L. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

M. Post-Installed Concrete Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Mechanical-Type Anchor Bolts: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors to be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive-Type Anchor Bolts: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of



the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.

5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

### 3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

Coordinate this article with Drawings.

- A. Install flexible connections in piping where they cross structural seismic joints and other points where differential movement may occur, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 211000 "Water-Based Fire-Suppression Systems" for piping flexible connections.

### 3.5 ADJUSTING

- A. Adjust isolators after system is at operating weight.
- B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

### 3.6 FIELD QUALITY CONTROL

Retain first option in "Testing Agency" Paragraph below if Owner will hire an independent testing agency.

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

Retain "Manufacturer's Field Service" Paragraph below to require a factory-authorized service representative 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. Tests and Inspections:
  1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
  2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
  3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.

4. Test at no fewer than four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.

D. Remove and replace malfunctioning units and retest as specified above.

See [Section 014000 "Quality Requirements"](#) for retesting and reinspecting requirements and [Section 017300 "Execution"](#) for requirements for correcting the Work.

E. Units will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION 210548

## SECTION 210553 - IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Valve tags.
5. Warning tags.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment-Label Schedule: Include a listing of all equipment to be labeled and the proposed content for each label.
- D. Valve-numbering scheme.
- E. Valve Schedules: Provide for fire-suppression piping system. Include in operation and maintenance manuals.

### PART 2 - PRODUCTS

#### 2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Brady Corporation.
  - b. Carlton Industries, LP.
  - c. Champion America.
  - d. Craftmark Pipe Markers.
  - e. Kolbi Pipe Marker Co.
  - f. LEM Products Inc.
  - g. Marking Services Inc.
  - h. Pipemarket.com; Brimar Industries, Inc.

- i. Seton Identification Products; a Brady Corporation company.
    - j. emedco.
  2. Material and Thickness: Brass, 0.032 inch thick, with predrilled or stamped holes for attachment hardware.
  3. Letter and Background Color: As indicated for specific application under Part 3.
  4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
  6. Fasteners: Stainless steel rivets or self-tapping screws.
  7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

## 2.2 WARNING SIGNS AND LABELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Brady Corporation.
  2. Carlton Industries, LP.
  3. Champion America.
  4. Craftmark Pipe Markers.
  5. LEM Products Inc.
  6. Marking Services Inc.
  7. National Marker Company.
  8. Pipemarker.com; Brimar Industries, Inc.
  9. Seton Identification Products; a Brady Corporation company.
  10. Stranco, Inc.
  11. emedco.
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

- G. Fasteners: Stainless steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Arc-Flash Warning Signs: Provide arc-flash warning signs in locations and with content in accordance with requirements of OSHA and NFPA 70E, and other applicable codes and standards.
- J. Label Content: Include caution and warning information, plus emergency notification instructions.

## 2.3 PIPE LABELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Actioncraft Products, Inc.; a division of Industrial Test Equipment Co., Inc.
  - 2. Brady Corporation.
  - 3. Carlton Industries, LP.
  - 4. Champion America.
  - 5. Craftmark Pipe Markers.
  - 6. Kolbi Pipe Marker Co.
  - 7. LEM Products Inc.
  - 8. Marking Services Inc.
  - 9. Pipemarker.com; Brimar Industries, Inc.
  - 10. Seton Identification Products; a Brady Corporation company.
  - 11. emedco.
- B. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- E. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- F. Pipe-Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include the following:
  - 1. Pipe size.
  - 2. Flow-Direction Arrows: Include flow-direction arrows on main distribution piping. Arrows may be either integral with label or applied separately.
  - 3. Lettering Size: At least 1/2 inch for viewing distances of up to 72 inches and proportionately larger lettering for greater viewing distances.

2.4 VALVE TAGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Actioncraft Products, Inc.; a division of Industrial Test Equipment Co., Inc.
2. Brady Corporation.
3. Carlton Industries, LP.
4. Champion America.
5. Craftmark Pipe Markers.
6. Kolbi Pipe Marker Co.
7. LEM Products Inc.
8. Marking Services Inc.
9. Pipemarker.com; Brimar Industries, Inc.
10. Seton Identification Products; a Brady Corporation company.
11. emedco.

- B. Description: Stamped or engraved with 1/4-inch letters for piping-system abbreviation and 1/2-inch numbers.
  - 1. Tag Material: Brass, 0.04 inch thick, with predrilled or stamped holes for attachment hardware.
  - 2. Fasteners: Brass wire.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
  - 1. Include valve-tag schedule in operation and maintenance data.

## 2.5 WARNING TAGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Brady Corporation.
  - 2. Champion America.
  - 3. Craftmark Pipe Markers.
  - 4. Kolbi Pipe Marker Co.
  - 5. LEM Products Inc.
  - 6. Marking Services Inc.
  - 7. Pipemarker.com; Brimar Industries, Inc.
  - 8. Seton Identification Products; a Brady Corporation company.
  - 9. emedco.
- B. Description: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
  - 1. Size: Approximately 4 by 7 inches.
  - 2. Fasteners: Brass grommet and wire.
  - 3. Nomenclature: Large-size primary caption, such as "DANGER," "CAUTION," or "DO NOT OPERATE."
  - 4. Letter and Background Color: As indicated for specific application under Part 3.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

### 3.2 INSTALLATION GENERAL REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be installed.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.
- D. Locate identifying devices so that they are readily visible from the point of normal approach.

### 3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

- A. Permanently fasten labels on each item of fire-suppression equipment.
- B. Sign and Label Colors:
  - 1. White letters on an ANSI Z535.1 safety-red background.
- C. Locate equipment labels where accessible and visible.
- D. Arc-Flash Warning Signs: Provide arc-flash warning signs on electrical disconnects and other equipment where arc-flash hazard exists, as indicated on Drawings, and in accordance with requirements of OSHA and NFPA 70E, and other applicable codes and standards.

### 3.4 INSTALLATION OF PIPE LABELS

- A. Piping Color Coding: Painting of piping is specified in Division 9 painting specification.
- B. Install pipe labels showing service and flow direction with permanent adhesive on pipes.
- C. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Within 3 ft. of each valve and control device.
  - 2. At access doors, manholes, and similar access points that permit a view of concealed piping.
  - 3. Within 3 ft. of equipment items and other points of origination and termination.
  - 4. Spaced at maximum intervals of 25 ft. along each run. Reduce intervals to 5 ft. in areas of congested piping and equipment.



- D. Flow- Direction Arrows: Provide arrows to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- E. Fire-Suppression Pipe Label Color Schedule:
  - 1. Fire-Suppression Pipe Labels: White letters on an ANSI Z535.1 safety-red background.

### 3.5 INSTALLATION OF VALVE TAGS

- A. Install tags on valves and control devices in fire-suppression piping systems. List tagged valves in a valve-tag schedule in the operating and maintenance manual. Include the identification "FSV" on all fire-suppression system valve tags.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below.
  - 1. Valve-Tag Size and Shape:
    - a. Fire-Suppression Standpipe: 2 inches, round.
    - b. Wet-Pipe Sprinkler System: 2 inches, round.
    - c. Dry-Pipe Sprinkler System: 2 inches, round.
    - d. Clean-Agent Fire-Extinguishing System: 2 inches, round.
    - e. Preaction System: 2 inches, round.
  - 2. Valve-Tag Color: White letters on an ANSI Z535.1 safety-red background.

### 3.6 INSTALLATION OF WARNING TAGS

- A. Warning Tag Color: Black letters on an ANSI Z535.1 safety-yellow background.
- B. Attach warning tags, with proper message, to equipment and other items where required per code, recommended by manufacturer, and directed by owner.

END OF SECTION 210553

## SECTION 211000 - WATER-BASED FIRE-SUPPRESSION SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Fire-suppression piping, fittings, and appurtenances.
2. Fire department connections.
3. Hose connections and hose stations.
4. System control valves.
5. Fire-suppression piping specialties.
6. Sprinklers.
7. Alarm devices.
8. Manual control stations.
9. Control panels.
10. Pressure gauges.

##### B. Related Requirements:

1. Section 331415 "Site Water Distribution Piping" for site fire-suppression water-service and backflow prevention devices.

#### 1.2 DEFINITIONS

- ##### A. Standard-Pressure Fire-Suppression System Piping:
- Piping designed to operate at working pressure of 175 psig maximum.

- B. High-Pressure Fire-Suppression System Piping: Piping designed to operate at working pressure higher than standard 175 psig, but not higher than 300 psig.

### 1.3 ACTION SUBMITTALS

- A. Product Data:

- 1. For each type of product.
  - a. Include construction details, material descriptions, dimensions of individual components and profiles.
  - b. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

- B. Shop Drawings:

- 1. Prepare in accordance with NFPA 13 section "Working Plans."
  - a. Include plans, elevations, and sections of the system piping and details.
  - b. Include detailed riser diagram and schematic diagram showing system supply, supply connection, devices, valves, pipe and fittings, as well as the delineation of the standard-pressure and high-pressure portions of the fire-suppression system.
  - c. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- 2. Prepare computer-generated hydraulic calculations in accordance with the following:
  - a. Minimum operating pressure at hydraulically most remote fire hose valve is to be 100 psig.
  - b. Name of hydraulic program used.
  - c. Water supply information, including fire hydrant flow test data report.
- 3. Submit documents and calculations signed and sealed by qualified professional engineer responsible for their preparation and prepared by NICET Level III-certified technician, "Water-Based Systems Layout."
- 4. Include diagrams for power, signal, and control wiring.

- C. Delegated Design Submittals: For fire-suppression systems indicated to comply with performance requirements and design criteria, including analysis data, signed and sealed by the qualified professional engineer responsible for their preparation.

### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Fire-suppression system plans and sections, or Building Information Model (BIM), drawn to scale, showing the items described in this Section and coordinated with all building trades.
- B. Qualification Data: For qualified Installer, professional engineer, and NICET-certified technician as applicable.
- C. Design Data: Approved fire-suppression piping working plans, prepared in accordance with NFPA 13, including documented approval by AHJs, and including hydraulic calculations if applicable.
- D. Welding certificates.
- E. Field Test Reports:
  - 1. Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
  - 2. Fire-hydrant flow test report.
- F. Field quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-suppression systems and specialties to include in emergency, operation, and maintenance manuals.

#### 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.
  - 2. System control valves.

## 1.7 QUALITY ASSURANCE

### A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
  - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by qualified professional engineer.

### B. Welding Qualifications: Qualify procedures and operators in accordance with ASME Boiler and Pressure Vessel Code.

## PART 2 - PRODUCTS

### 2.1 SYSTEM DESCRIPTION

- A. Automatic wet-pipe sprinkler system.
- B. Automatic dry-pipe sprinkler.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Suppression System Components, Devices, and Accessories: Listed in UL's "Fire Protection Equipment Directory" and FM Approvals' "Approval Guide."

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fire-suppression system equipment, specialties, accessories, installation, and testing to comply with NFPA 13 and ASME A17.1.
- D. Standard-Pressure Piping System Component: Listed for 175 psig minimum working pressure.
- E. High-Pressure Piping System Component: Listed for 300 psig working pressure.
- F. Delegated Design: Engage a qualified professional engineer to design fire-suppression systems.
  - 1. Fire-Hydrant Flow Test:
    - a. Perform fire-hydrant flow test and record the following conditions:
      - 1) Date: August 3, 2023.
      - 2) Time: 1:42 pm.
      - 3) Performed by: Veolia.
      - 4) Location of Residual Fire Hydrant R: 31-201.
      - 5) Location of Flow Fire Hydrant F: 31-202.
      - 6) Static Pressure at Residual Fire Hydrant R: 75 psi.
      - 7) Measured Flow at Flow Fire Hydrant F: 1126 gpm.
      - 8) Residual Pressure at Residual Fire Hydrant R: 65 psi.
    - b. Fire-hydrant flow test must be performed within previous 12 months prior to completion of design documents and hydraulic calculations.
  - 2. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
  - 3. Sprinkler Occupancy Hazard Classifications: See drawings.
  - 4. Minimum Density for Automatic-Sprinkler Piping Design: See drawings.
  - 5. Maximum protection area per sprinkler in accordance with UL listing.

6. Total Combined Hose-Stream Demand Requirement: In accordance with NFPA 13 unless otherwise indicated:
  - a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
  - b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.
  - c. Extra-Hazard Occupancies: 500 gpm for 90 to 120 minutes.

G. Obtain documented approval of fire-suppression system design from AHJs.

## 2.3 FIRE-SUPPRESSION PIPING, FITTINGS, AND APPURTENANCES

### A. Steel Pipe, Fittings, and Appurtenances:

1. Schedule 40 Steel Pipe: Galvanized and Black-steel pipe, ASTM A53/A53M, ASTM A135/A135M, or ASTM A795/A795M.
  - a. Standards:
    - 1) UL 852.
    - 2) FM 1630.
  - b. Factory-applied exterior coating.
  - c. Factory-applied bacterial-resistant internal coating to reduce microbiologically influenced corrosion.
  - d. Pipe ends may be factory or field formed to match joining method.
2. Schedule 10 Steel Pipe: Black-steel pipe, ASTM A53/A53M, ASTM A135/A135M, or ASTM A795/A795M.
  - a. Standards:
    - 1) UL 852.
    - 2) FM 1630.
  - b. Factory-applied exterior coating.
  - c. Factory-applied bacterial resistant internal coating to reduce microbiologically influenced corrosion.
  - d. Pipe ends may be factory or field formed to match joining method.
3. Steel Pipe Nipples: Galvanized and black steel, ASTM A733, made of ASTM A53/A53M, standard-weight, seamless steel pipe with threaded ends.

4. Steel Couplings: Galvanized and uncoated steel, ASTM A865/A865M, threaded.
5. Gray-Iron Threaded Fittings: Galvanized and uncoated gray-iron threaded fittings, ASME B16.4, Class 125, standard pattern.
6. Malleable- or Ductile-Iron Unions: ASME B16.3.
7. Cast-Iron Flanges: ASME B16.1, Class 125.
8. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
  - a. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick ASME B16.21, nonmetallic and asbestos free, or EPDM rubber gasket.
    - 1) Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.
    - 2) Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.
  - b. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1 carbon steel unless otherwise indicated.
9. Steel Welding Fittings: ASTM A234/A234M and ASME B16.9.
  - a. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
10. Grooved-Joint, Steel-Pipe Appurtenances:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Gruvlok; an ASC Engineered Solution.
    - 2) SPF/Anvil; an ASC Engineered Solution.
    - 3) Shurjoint; a part of Aalberts Integrated Piping Systems.
    - 4) Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
    - 5) Victaulic Company.
  - b. Pressure Rating: 300 psig minimum.



- c. Grooved-End Fittings for Steel Piping: Painted grooved-end fittings, ASTM A47/A47M, malleable-iron casting or ASTM A536, ductile-iron casting, with dimensions matching steel pipe.
- d. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

## 2.4 FIRE DEPARTMENT CONNECTIONS

### A. Fire Department Connection, Flush Type:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Croker; a Division of Morris Group International.
  - b. Elkhart Brass Mfg. Co., Inc.
  - c. Guardian Fire Equipment, Inc.
  - d. Potter Roemer LLC; a Division of Morris Group International.
- 2. Standard: UL 405.
- 3. Description: Flush Mounted.
- 4. Pressure Rating: 300 psig.
- 5. Body Material: Corrosion-resistant metal.
- 6. Inlets: Brass with threads in accordance with NFPA 1963 and matching local fire department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
- 7. Caps: Brass, lugged type, with gasket and chain.
- 8. Escutcheon Plate: Round, brass, floor type.
- 9. Escutcheon Plate Marking: "AUTO SPKR".
- 10. Finish, Including Sleeve: Rough chrome plated.
- 11. Outlet Size: NPS 6.

## 2.5 SYSTEM CONTROL VALVES

- A. Listed in UL's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide."
- B. Pressure Rating:
  - 1. Standard-Pressure Piping Valves: 175 psig minimum.
  - 2. High-Pressure Piping Valves: 300 psig.
- C. Body Material: Cast or ductile iron.
- D. Size: Same as connected piping.
- E. End Connections: Flanged or grooved.

F. System Control Valve, Alarm Valve:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Reliable Automatic Sprinkler Co., Inc. (The).
  - b. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
  - c. Venus Fire Protection Ltd.
  - d. Victaulic Company.
  - e. Viking Group Inc.
2. Standard: UL 193.
3. Design: For horizontal or vertical installation.
4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gauges, and fill-line attachment with strainer.
5. Drip cup assembly pipe drain with check valve to main drain piping.

G. System Control Valve, Dry-Pipe Valve:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Reliable Automatic Sprinkler Co., Inc. (The).
  - b. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
  - c. Venus Fire Protection Ltd.
  - d. Victaulic Company.
  - e. Viking Group Inc.
2. Standards:
  - a. UL 260.
  - b. UL 1486.
3. Design: Differential-pressure type.
4. Include quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gauges, priming chamber attachment, and fill-line attachment.
5. Air Compressor for Dry-Pipe Valve:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Gast Manufacturing Inc.
    - 2) General Air Products, Inc.
    - 3) Viking Group Inc.
  - b. Motor Horsepower: Fractional.

- c. Power: 120 V ac, 60 Hz, single phase.
- d. Sized for application and capable of achieving system supervisory pressure within 30 minutes in accordance with requirements of NFPA standards. Provide ASME air receiver tank as required to meet requirements on larger systems.
- e. Include filters, relief valves, coolers, automatic drains, and gauges.

H. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Shurjoint; a part of Aalberts Integrated Piping Systems.
  - b. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
  - c. Victaulic Company.
2. Standard: UL 213.
3. Pressure Rating: 300 psig.
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-tee and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

I. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AGF Manufacturing, Inc.
  - b. Reliable Automatic Sprinkler Co., Inc. (The).
  - c. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
  - d. Victaulic Company.
2. Standard: UL's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide."
3. Pressure Rating: 300 psig.
4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded or grooved.

J. Branch Line Testers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AGF Manufacturing, Inc.
  - b. Croker; a Division of Morris Group International.
  - c. Potter Roemer LLC; a Division of Morris Group International.
2. Standard: UL 199.
3. Pressure Rating: 175 psig.
4. Body Material: Brass.
5. Size: Same as connected piping.
6. Inlet: Threaded.
7. Drain Outlet: Threaded and capped.
8. Branch Outlet: Threaded, for sprinkler.

K. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Reliable Automatic Sprinkler Co., Inc. (The).
  - b. Viking Group Inc.

2. Standard: UL's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide."
3. Pressure Rating: 300 psig.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

L. Adjustable Drop Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. Aegis Technologies, Inc.
2. Standard: UL 1474.
3. Pressure Rating: 300 psig.
4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

M. Flexible Sprinkler Hose Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. ALEUM USA.
  - b. Flexhead; an ASC Engineered Solution.
  - c. Victaulic Company.
2. Standards:
  - a. UL 2443.
  - b. FM 1637.
3. Description: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
4. Pressure Rating: 300 psig.
5. Size: Same as connected piping, for sprinkler.

N. Automatic (Ball-Drip) Drain Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Reliable Automatic Sprinkler Co., Inc. (The).
    - b. Viking Group Inc.
  2. Pressure Rating: 175 psig minimum.
  3. Type: Automatic draining, ball check.
  4. Size: NPS 3/4.
  5. End Connections: Threaded.
- O. Automatic Air Vent Assembly:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. AGF Manufacturing, Inc.
    - b. Engineered Corrosion Solutions.
    - c. South-Tek Systems, LLC.
  2. Description: Automatic air vent assembly that automatically vents trapped air without human intervention, including Y-strainer and ball valve in a pre-piped assembly. Approved for use in wet-pipe fire-suppression system.
  3. Vents oxygen continuously from system.
  4. Float valve to prevent water discharge.
  5. Minimum Water Working Pressure Rating: 175 psig.

## 2.6 SPRINKLERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Reliable Automatic Sprinkler Co., Inc. (The).
  2. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
  3. Victaulic Company.
  4. Viking Group Inc.
- B. Standards:
1. UL 199.
  2. UL 1767.
  3. UL 1626.
  4. FM 2000.

5. FM 2008.
6. FM 2030.
- C. Listed in UL's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide."
- D. Pressure Rating for Sprinklers:
  1. Standard Automatic Sprinklers: 175 psig minimum.
- E. Sprinklers, Automatic Wet with Heat-Responsive Element:
  1. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
  2. Standard Spray, Standard Response:
    - a. Upright.
  3. Standard Spray, Quick Response:
    - a. Upright.
    - b. Flat, concealed pendent.
- F. Sprinklers, Automatic Dry with Heat-Responsive Element:
  1. Standard Spray, Quick Response:
    - a. Upright.
- G. Sprinkler Finishes: Bronze, White, Corrosion-resistant.
- H. Sprinkler Guards and Water Shields:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Reliable Automatic Sprinkler Co., Inc. (The).
    - b. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
    - c. Victaulic Company.
    - d. Viking Group Inc.
  2. Standard: UL 199.
  3. Description: Wire cage with fastening device for attaching to sprinkler.

## 2.7 ALARM DEVICES

- A. Match alarm-device material and connection types to piping and equipment materials and connection types.
- B. Water-Flow Indicators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Potter Electric Signal Company, LLC.
    - b. System Sensor; Honeywell International, Inc.
    - c. Viking Group Inc.
  2. Standard: UL 346.
  3. Water-Flow Detector: Electrically supervised.
  4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125 V ac and 0.25 A, 24 V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
  5. Type: Paddle operated.
  6. Pressure Rating: 250 psig.
  7. Design Installation: Horizontal or vertical.
- C. Pressure Switches - Water-Flow Alarm Detection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Potter Electric Signal Company, LLC.
    - b. System Sensor; Honeywell International, Inc.
  2. Description: Electrically supervised, pressure-activated water-flow switch with retard feature.



3. Components: Two single-pole, double-throw switches with normally closed contacts.
4. Design Operation: Rising pressure to 6 psi, plus or minus 2 psi signals water flow.
5. Adjustability: Each switch is to be independently adjustable.
6. Wire Separation: Pressure switch to provide for separation of wiring to each switch connection to allow for low- and high-voltage connections to comply with NFPA 70, Article 760 requirements.

D. Valve Supervisory Switches:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Kennedy Valve Company; a division of McWane, Inc.
  - b. Potter Electric Signal Company, LLC.
  - c. System Sensor; Honeywell International, Inc.
2. Standard: UL 346.
3. Type: Electrically supervised.
4. Design: Signals that controlled valve is in other than fully open position.
5. Wire Terminal Designations: Indicates normal switch position when switch is properly installed on valve and valve is fully open.
6. 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.
7. OS&Y Valve Supervisory Switches:
  - a. One or two single-pole, double-throw switches.
  - b. NEMA Rating: NEMA 4 and NEMA 6P enclosures suitable for mounting in any position indoors or outdoors.
  - c. Visual Switch Indication: Indicates device is properly installed and OS&Y valve is fully open.
  - d. Mounting Hardware: Mounting bracket to grip valve yoke and prevent movement of switch assembly on OS&Y valve.
  - e. Trip Rod Length: Adjustable

2.8 MANUAL CONTROL STATIONS

- A. Listed in UL's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide"
- B. Description: For hydraulic operation, with union, NPS 1/2 pipe nipple, and bronze ball valve.
- C. Include metal enclosure labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.

## 2.9 CONTROL PANELS

- A. Description: Single-area, two-area, or single-area cross-zoned control panel as indicated, including NEMA ICS 6, Type 1 enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves.
  - 1. Listed in UL's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide" when used with thermal detectors and Class A detector circuit wiring.
  - 2. Electrical characteristics are 120 V ac, 60 Hz, with 24 V dc rechargeable batteries.
  - 3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Manual Control Stations, Electric Operation: Metal enclosure, labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.
- C. Panel Components:
  - 1. Power supply.
  - 2. Battery charger.
  - 3. Standby batteries.
  - 4. Field-wiring terminal strip.
  - 5. Electrically supervised solenoid valves and polarized fire-alarm bell.
  - 6. Lamp test facility.
  - 7. Single-pole, double-throw auxiliary alarm contacts.
  - 8. Rectifier.

## 2.10 PRESSURE GAUGES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AGF Manufacturing, Inc.
  - 2. Ametek U.S. Gauge.
  - 3. Ashcroft Inc.
  - 4. Brecco Corporation.
  - 5. WIKA Instrument Corporation.
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch diameter.

- D. Pressure Gauge Range: 0 to 300 psig.
- E. Water System Piping Gauge: Include "WATER" or "AIR/WATER" label on dial face.
- F. Air System Piping Gauge: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Perform fire-hydrant flow test. Use results for system design calculations required in "Quality Assurance" Article.
  - 1. Flow test is to be performed to meet the criteria established by NFPA 13.
  - 2. Flow test is to be conducted in accordance with NFPA 291.
  - 3. Test is to be performed during a period of ordinary demand for the water system.
    - a. To obtain satisfactory test results of expected flow or rated capacities, sufficient discharge should be achieved to cause drop of at least 10 percent.
  - 4. Pitot readings are to be taken at the 2-1/2-inch orifice connection.
  - 5. The pitot reading is to range from 10 to 35 psig.
  - 6. Open additional hydrant outlets as needed to control pitot readings.
  - 7. The pitot pressure and corresponding residual pressure readings are to be taken consecutively as pressure fluctuates between a high number and low number.
- B. Flow Test Data Written Report:
  - 1. Flow data report is to be written in accordance with NFPA 291.
  - 2. Flow data report is to include a copy of all flow data recorded during the test, including a site plan showing the tested fire hydrants with respect to the fire water service to the building. Site plan is to indicate which hydrant was flowed and which hydrant was used for pressure reading. Provide date of test, name of testing agency, and name of individual performing test.
- C. Water Supply Curve: Provide water supply curve based on the lowest supply for a given set of test data. For a given residual pressure reading, the supply is to be graphed utilizing the corresponding pitot pressure/flow reading and static pressure reading.
- D. Documentation is to include calibration certifications for gauges used in the flow tests. The certifications are to be from within the previous six (6) months from a reputable agency recognized for certifying pressure gauges.
- E. Report flow test results promptly and in writing. A copy of the flow test data report is to be submitted with the hydraulic calculations.

3.2 INSTALLATION OF FIRE-SUPPRESSION WATER-SERVICE PIPING

- A. Comply with requirements for fire-suppression water-service piping in Section 331415 "Site Water Distribution Piping."

3.3 INSTALLATION OF FIRE-SUPPRESSION PIPING

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.
  - 1. Deviations from approved working plans for piping require written approval from AHJs. File written approval with Architect before deviating from approved working plans.
  - 2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.
- B. Piping Standard: Comply with NFPA 13 requirements for installation of fire-suppression piping.
- C. Install seismic restraints on piping. Comply with NFPA standards requirements for seismic-restraint device materials and installation.
- D. Install listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- G. Install inspector's test connections in sprinkler system piping, complete with shutoff valve, and sized and located in accordance with NFPA 13.
- H. Install fire-suppression system piping with drains for complete system drainage. Extend drain piping to exterior of building where possible.
- I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- J. Install automatic (ball drip) drain valve at each check valve for fire department connection, to drain piping between fire department connection and check valve. Install drain piping to and spill over floor drain or to exterior of building.
- K. Install alarm devices in piping systems.

- L. Install hangers and supports for fire-suppression piping in accordance with NFPA standards. Comply with requirements for hanger materials in NFPA standards.
- M. Install pressure gauges on riser or feed main, at each sprinkler test connection, and at top of each standpipe/sprinkler supply. Include pressure gauges with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal, and install where they are not subject to freezing.
- N. Pressurize and check dry-pipe and preaction sprinkler system piping and air compressors.
- O. Fill wet-type fire-suppression system piping with water.
- P. Drain dry-type fire-suppression system piping.
- Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210500 "Common Work Results for Fire-Suppression Piping."
- R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210500 "Common Work Results for Fire-Suppression Piping."
- S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210500 "Common Work Results for Fire-Suppression Piping."

### 3.4 INSTALLATION OF PIPING JOINTS

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts in accordance with ASME B31.9.

- G. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Welded Joints: Construct joints in accordance with AWS D10.12M/D10.12, using qualified processes and welding operators in accordance with "Quality Assurance" Article.
  - 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
- I. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe in accordance with AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings in accordance with AWWA C606 for steel-pipe joints.
- J. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe in accordance with AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings in accordance with AWWA C606 for steel-pipe grooved joints.

### 3.5 INSTALLATION OF FIRE DEPARTMENT CONNECTIONS

- A. Install yard-type fire department connections in concrete slab support. Comply with requirements for concrete in Section 033000 "Cast-in-Place Concrete."
- B. Install three protective pipe bollards around each fire department connection. Comply with requirements for bollards in Section 055000 "Metal Fabrications."
- C. Install automatic (ball-drip) drain valve at each check valve for fire department connection.

### 3.6 INSTALLATION OF VALVES AND SPECIALTIES

- A. Install listed fire-suppression system control valves, trim and drain valves, specialty valves and trim, controls, and specialties in accordance with manufacturer's installation instructions, NFPA standards, and AHJ.
- B. Install listed fire-suppression system shutoff valves in supervised open position, located to control sources of water supply except from fire department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. System Control Valves:
  - 1. Install alarm valves with bypass check valve and retarding chamber drain-line connection.
  - 2. Install dry-pipe and preaction valves with trim sets for air supply, drain, priming level, alarm connections, ball-drip valves, pressure gauges, priming chamber attachment, and fill-line attachment.

- a. Install air compressor and compressed-air-supply piping.

D. Air Vent:

1. Provide at least one air vent at high point in each wet-pipe fire-suppression system in accordance with NFPA standards. Connect vent into top of fire-suppression piping.
2. Provide dielectric union for dissimilar metals, ball valve, and strainer upstream of automatic air vent.
3. Pipe from outlet of air vent to drain.

3.7 INSTALLATION OF SPRINKLERS

- A. Install sprinklers in suspended ceilings symmetrically in center of acoustical ceiling panels within tolerance of 1/2 inch. Coordinate entire pattern of sprinkler locations with approved reflected ceiling plan.
- B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
- C. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

3.8 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping in accordance with requirements for identification specified in Section 210553 "Identification for Fire-Suppression Piping and Equipment."
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
  2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  3. Flush, test, and inspect fire-suppression systems in accordance with NFPA standards.
  4. Energize circuits to electrical equipment and devices.
  5. Start and run air compressors.
  6. Coordinate with fire-alarm tests. Operate as required.
  7. Verify that equipment hose threads are same as local fire department equipment.
  8. Verify that sprinklers original factory finish has not been contaminated with dirt, debris, or paint. Sprinklers containing other-than-original factory finish are to be considered defective and replaced with new products. Repair and/or cleaning is not acceptable.
- C. Fire-suppression piping system will be considered defective if it does not pass tests and inspections.
- D. Fire-suppression piping system components considered defective during testing will be replaced with new components. Repair of defective components is not acceptable.
- E. Prepare test and inspection reports.

### 3.10 CLEANING

- A. Clean dirt and debris from fire-suppression system piping, system control valves, sprinklers, and associated components.
- B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

### 3.11 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain system control valves and pressure-maintenance pumps.

### 3.12 PIPING SCHEDULE



- A. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends, grooved-end fittings, grooved-end-pipe couplings, and grooved joints.
- B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
- C. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 1-1/4 and Smaller, to Be One of the Following:
  - 1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
- D. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 1-1/2 to NPS 8, to Be One of the Following:
  - 1. Schedule 10, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
- E. Standard-Pressure, Dry-Pipe Sprinkler System, NPS 1-1/4 and Smaller, to Be One of the Following:
  - 1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
- F. Standard-Pressure, Dry-Pipe Sprinkler System, NPS 1-1/2 to NPS 8, to Be One of the Following:
  - 1. Schedule 40, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

### 3.13 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Flat concealed sprinklers.
3. Spaces Subject to Freezing: Upright sprinklers, dry pendent sprinklers, and dry sidewall sprinklers as indicated.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces and locations not generally exposed to view; and wax coated where exposed to acids, chemicals, or other corrosive fumes.
2. Recessed Sprinklers: Bright chrome, with factory-painted white escutcheon.

END OF SECTION 211000

## SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Motors.
2. Packless expansion joints.
3. Grooved-joint expansion joints, lead free.
4. Alignment guides and anchors.
5. Sleeves without waterstop.
6. Sleeves with waterstop.
7. Stack-sleeve fittings.
8. Sleeve-seal systems.
9. Grout.
10. Silicone sealants.
11. Escutcheons.
12. Thermometers, bimetallic actuated, lead free.
13. Thermometers, filled system, lead free.
14. Thermometers, liquid in glass, lead free.
15. Thermometers, light activated, lead free.
16. Thermowells, lead free.
17. Pressure gauges, dial type, lead free.
18. Gauge attachments, lead free.
19. Test plugs, lead free.
20. Test-plug kits, lead free.
21. Sight flow indicators, lead free.

##### B. Related Requirements:

1. Section 221119 "Domestic Water Piping Specialties" for water meters.
2. Section 221513 "General-Service Compressed-Air Piping" for compressed air gauges.

3. Section 331415 "Site Water Distribution Piping" for domestic water meters and combined domestic and fire-protection water-service meters outside the building.

## 1.2 DEFINITIONS

- A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

## 1.3 ACTION SUBMITTALS

### A. Product Data:

1. For each type of product, excluding motors which are included in Part 1 of the plumbing equipment Sections.
  - a. Include construction details, material descriptions, and dimensions of individual components, and finishes.
  - b. Include operating characteristics and furnished accessories.

### B. Delegated Design Submittals: For each anchor and alignment guide, including analysis data, signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
3. Alignment Guide Details: Detail field assembly and attachment to building structure.
4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

## 1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Field quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of expansion joint, and gauge to include in operation and maintenance manuals.

#### 1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.
- B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators in accordance with 2021 ASME Boiler and Pressure Vessel Code, Section IX.

#### 1.7 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
  - 1. Motor controllers.
  - 2. Torque, speed, and horsepower requirements of the load.
  - 3. Ratings and characteristics of supply circuit and required control sequence.
  - 4. Ambient and environmental conditions of installation location.

### PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

- A. Domestic water expansion fittings and loops for plumbing piping intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act, with requirements of authorities having jurisdiction, and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
- B. Compatibility: Provide products suitable for piping service fluids, materials, working pressures, and temperatures.
- C. Capability: Provide products and installations to accommodate maximum axial movement as scheduled or indicated on Drawings.

## 2.2 MOTORS

- A. Motor Requirements, General:
  - 1. Content includes motors for use on alternating-current power systems of up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.
  - 2. Comply with requirements in this Section except when stricter requirements are specified in equipment schedules or Sections.
  - 3. Comply with NEMA MG 1 unless otherwise indicated.
  - 4. Comply with IEEE 841 for severe-duty motors.
- B. Motor Characteristics:
  - 1. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 ft. above sea level.
  - 2. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

C. Polyphase Motors:

1. Description: NEMA MG 1, Design B, medium induction motor.
2. Efficiency: Premium Efficient, as defined in NEMA MG 1.
3. Service Factor: 1.15.
4. Multispeed Motors: Variable torque.
  - a. For motors with 2:1 speed ratio, consequent pole, single winding.
  - b. For motors with other than 2:1 speed ratio, separate winding for each speed.
5. Multispeed Motors, Two Winding: Separate winding for each speed.
6. Rotor: Random-wound, squirrel cage.
7. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
8. Temperature Rise: Match insulation rating.

9. Insulation: Class F.
10. Code Letter Designation:
  - a. Motors 15 HP and Larger: NEMA starting Code F or Code G.
  - b. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.
11. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

D. Additional Requirements for Polyphase Motors:

1. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
2. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
  - a. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time-rise pulses produced by pulse-width-modulated inverters.
  - b. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
  - c. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
  - d. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.



3. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

E. Single-Phase Motors:

1. Motors larger than 1/20 hp must be one of the following, to suit starting torque and requirements of specific motor application:
  - a. Permanent-split capacitor.
  - b. Split phase.
  - c. Capacitor start, inductor run.
  - d. Capacitor start, capacitor run.
2. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
3. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
4. Motors 1/20 HP and Smaller: Shaded-pole type.
5. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device will automatically reset when motor temperature returns to normal range.

F. Electronically Commutated Motors:

1. Microprocessor-Based Electronic Control Module: Converts 120 V or 240 V single-phase AC power to three-phase DC power to operate the brushless DC motor.
2. Three-phase power motor module with permanent magnet rotor.
3. Circuit board or digital speed controller/LED display.
4. Building Automation System Interface: Via AC voltage signal DC voltage signal or Digital Serial Interface (DSI).

## 2.3 EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

A. Performance Requirements:

1. Compatibility: Provide products suitable for piping service fluids, materials, working pressures, and temperatures.
2. Capability: Provide products and installations that will accommodate maximum axial movement as scheduled or indicated on Drawings.

B. Packless Expansion Joints:

1. Flexible-Hose Packless Expansion Joints, Lead Free:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) ASC Engineered Solutions.
    - 2) Flex-Hose Co., Inc.
    - 3) Flex-Pression.
    - 4) Flex-Weld; a division of Kelco.
    - 5) Flexicraft Industries.
    - 6) Kadant Unaflex, LLC.
    - 7) Mason Industries, Inc.
    - 8) Proco Products, Inc.
    - 9) Unisource Manufacturing, Inc.
  - b. Source Limitations: Obtain flexible-hose packless expansion joints from single manufacturer.
  - c. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
  - d. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
  - e. Expansion Joints for Copper Tubing NPS 2 (DN 50) and Smaller: Copper-alloy fittings with solder-joint end connections.
    - 1) Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F and 340 psig at 450 deg F ratings.
    - 2) Bronze hoses and double-braid bronze sheaths with 700 psig at 70 deg F and 500 psig at 450 deg F ratings.
  - f. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Copper-alloy fittings with threaded end connections.
    - 1) Stainless steel hoses and single-braid, stainless steel sheaths with 300 psig at 70 deg F and 225 psig at 450 deg F ratings.
    - 2) Stainless steel hoses and double-braid, stainless steel sheaths with 420 psig at 70 deg F and 315 psig at 450 deg F ratings.
  - g. Expansion Joints for Stainless Steel Piping NPS 2 (DN 50) and Smaller: Stainless steel fittings with threaded end connections.
    - 1) Stainless steel hoses and single-braid, stainless steel sheaths with 450 psig at 70 deg F and 325 psig at 600 deg F ratings.

- 2) Stainless steel hoses and double-braid, stainless steel sheaths with 700 psig at 70 deg F and 515 psig at 600 deg F ratings.
- h. Expansion Joints for Stainless Steel Piping NPS 2-1/2 to NPS 6 (DN 65 to DN 150): Stainless steel fittings with flanged end connections.
  - 1) Stainless steel hoses and single-braid, stainless steel sheaths with 200 psig at 70 deg F and 145 psig at 600 deg F ratings.
  - 2) Stainless steel hoses and double-braid, stainless steel sheaths with 275 psig at 70 deg F and 200 psig at 600 deg F ratings.

C. Alignment Guides and Anchors:

1. Alignment Guides:

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1) ASC Engineered Solutions.
  - 2) Advanced Thermal Systems, Inc.
  - 3) Flex-Hose Co., Inc.
  - 4) Flex-Weld; a division of Kelco.
  - 5) Flexicraft Industries.
  - 6) Hyspan Precision Products, Inc.
  - 7) Metraflex Company (The).
- b. Source Limitations: Obtain alignment guides from single manufacturer.
- c. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding slider for bolting to pipe. Provide dielectric spacer for use with copper tubing/piping.

2. Anchor Materials:

- a. Steel Shapes and Plates: ASTM A36/A36M.
- b. Bolts and Nuts: ASME B18.10 or ASTM A183, steel hex head.
- c. Washers: ASTM F844, steel, plain, flat washers.
- d. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
  - 1) Stud: Threaded, stainless steel.

- 2) Expansion Plug: Stainless steel.
  - 3) Washer and Nut: Stainless steel.
- e. Chemical Fasteners: Insert-type stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.
- 1) Bonding Material: ASTM C881/C881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
  - 2) Stud: ASTM A307, stainless steel with continuous thread on stud unless otherwise indicated.
  - 3) Washer and Nut: Stainless steel.

## 2.4 SLEEVES AND SLEEVE SEALS

### A. Sleeves without Waterstop:

1. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron, with plain ends.
2. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, hot-dip galvanized, with plain ends.
3. Steel Sheet Sleeves: ASTM A653/A653M, 24 gauge minimum thickness; hot-dip galvanized, round tube closed with welded longitudinal joint.

### B. Sleeves with Waterstop:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Advance Products & Systems, LLC.
  - b. CALPICO, Inc.
  - c. GPT; a division of EnPRO Industries.
  - d. Metraflex Company (The).
2. Description: Manufactured steel, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.

### C. Stack-Sleeve Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Jay R. Smith Mfg Co; a division of Morris Group International.
  - b. Wade; a subsidiary of McWane Inc.
  - c. Zurn Industries, LLC.
2. Description: Manufactured, Dura-coated or Duco-coated cast-iron sleeve with integral clamping flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.
  - a. Underdeck Clamp: Clamping ring with setscrews.

D. Sleeve-Seal Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Advance Products & Systems, LLC.
  - b. GPT; a division of EnPRO Industries.
  - c. Metraflex Company (The).
  - d. Proco Products, Inc.
2. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
  - a. Hydrostatic Seal: 20 psig minimum.
  - b. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

- c. Pressure Plates: Stainless steel.
- d. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

E. Grout:

- 1. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
- 2. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- 3. Design Mix: 5000 psi, 28-day compressive strength.
- 4. Packaging: Premixed and factory packaged.

2.5 ESCUTCHEONS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1. BrassCraft Manufacturing Co.; a Masco company.
- 2. Dearborn Brass.
- 3. Jones Stephens Corp.
- 4. Keeney Manufacturing Company (The).
- 5. Mid-America Fittings, LLC; A Midland Industries Company.
- 6. ProFlo; a Ferguson Enterprises, Inc. brand.

B. Escutcheon Types:

- 1. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

C. Floor Plates:

- 1. Split Floor Plates: Cast brass with concealed hinge.

2.6 METERS AND GAUGES FOR PLUMBING PIPING

A. Thermometers, Liquid in Glass, Lead Free - Metal Case, Industrial Style:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Blue Ribbon Corp.
  - b. Flo Fab Inc.
  - c. Miljoco Corporation.
  - d. Palmer Wahl Instrumentation Group.
  - e. Terice, H. O. Co.
  - f. Weiss Instruments, Inc.
  - g. Weksler Glass Thermometer Corp.
  - h. Winters Instruments - U.S.

2. Source Limitations: Provide liquid-in-glass, lead-free, metal-case, industrial-style thermometers from single manufacturer.
3. Standard: ASME B40.200.
4. Case: Cast aluminum; 7-inch nominal size unless otherwise indicated.
5. Case Form: Adjustable angle unless otherwise indicated.
6. Tube: Glass with magnifying lens and blue organic liquid, mercury free.
7. Tube Background: Nonreflective aluminum with permanent scale markings graduated in deg F and deg C.
8. Window: Safety glass.
9. Stem: Aluminum and of length to suit installation.

- a. Design for Thermowell Installation: Bare stem.
10. Connector: 1-1/4 inches, with ASME B1.1 or ASME B1.20.1 screw threads to fit thermowell.
11. Accuracy: Plus or minus 1 percent of span or one scale division, to a maximum of 1.5 percent of span.
- B. Thermowells, Lead Free:
  1. Standard: ASME B40.200.
  2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
  3. Material for Use with Copper Tubing: Lead-free copper.
  4. Material for Use with Steel Piping: Type 304 stainless steel.
  5. Type: Stepped shank unless straight or tapered shank is indicated.
  6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, or as required to match threaded opening in pipe.
  7. Internal Threads: Size and thread type as required to match thermometer mounting threads.
  8. Bore: Diameter required to match thermometer bulb or stem.
  9. Insertion Length: Length to extend to center of pipe.
  10. Lagging Extension: Include on thermowells for insulated piping and tubing. Extension is to be of sufficient length to extend beyond finished insulation surface.
  11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
  12. Heat-Transfer Medium: Mixture of graphite and glycerin.
- C. Pressure Gauges, Dial Type, Lead Free - Direct Mounted, Metal Case:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Blue Ribbon Corp.
    - b. Flo Fab Inc.
    - c. Miljoco Corporation.
    - d. Palmer Wahl Instrumentation Group.
    - e. Terice, H. O. Co.
    - f. Weiss Instruments, Inc.
    - g. Weksler Glass Thermometer Corp.
    - h. Winters Instruments - U.S.
  2. Source Limitations: Provide dial-type, lead-free, direct-mounted, metal-case pressure gauges from single manufacturer.
  3. Standard: ASME B40.100.
  4. Case: Solid-front, pressure-relief type(s); cast aluminum or drawn steel; 6-inch nominal diameter.
  5. Pressure-Element Assembly: Lead-free Bourdon tube.
  6. Pressure Connection: Lead-free brass, with NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.



7. Movement: Mechanical, with link to pressure element and connection to pointer.
8. Dial: Nonreflective aluminum with permanent scale markings graduated in psi and kPa.
9. Pointer: Dark-colored metal.
10. Window: Safety glass.
11. Ring: Stainless steel.
12. Accuracy: Grade A, plus or minus 1 percent of middle half of span.

D. Gauge Attachments, Lead Free:

1. Snubbers: ASME B40.100, lead-free brass; with NPS 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.
2. Valves: Lead-free brass or stainless steel needle, with NPS 1/2, ASME B1.20.1 pipe threads.

E. Test Plugs, Lead Free:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. IMI Flow Design, Inc.
  - b. Miljoco Corporation.
  - c. Nexus Valve, Inc.; Aalberts Hydronic Flow Control.
  - d. Peterson Equipment Co., Inc.
  - e. Trerice, H. O. Co.
  - f. WATTS; A Watts Water Technologies Company.
  - g. Weiss Instruments, Inc.
  - h. Weksler Glass Thermometer Corp.
2. Source Limitations: Provide lead-free test plugs from single manufacturer.
3. Description: Test-station fitting made for insertion into piping tee fitting.
4. Body: Lead-free brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
5. Thread Size: NPS 1/2, ASME B1.20.1 pipe thread.
6. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
7. Core Inserts: EPDM self-sealing rubber.

F. Test-Plug Kits, Lead Free:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Blue Ribbon Corp.
  - b. Peterson Equipment Co., Inc.
2. Source Limitations: Provide lead-free test-plug kits from single manufacturer.
3. Furnish one test-plug kit(s) containing two thermometer(s), one pressure gauge and adapter, and carrying case. Thermometer sensing elements, pressure gauge, and adapter probes are to be of diameter to fit test plugs and of length to project into piping.

4. High-Range Thermometer, Lead Free: Small, bimetallic insertion type with 1- to 2-inch-diameter dial and tapered-end sensing element. Dial range is to be at least 0 to 220 deg F.
5. Pressure Gauge, Lead Free: Small, lead-free Bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range is to be at least 0 to 200 psig.
6. Carrying Case: Metal or plastic, with formed instrument padding.

G. Sight Flow Indicators, Lead Free:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. ARCHON Industries, Inc.
  - b. Dwyer Instruments, Inc.
  - c. Ernst Flow Industries.
  - d. John C. Ernst Co., Inc.
  - e. KOBOLD Instruments, Inc. - USA.
  - f. OPW Engineered Systems; OPW Fluid Transfer Group; a Dover company.
2. Source Limitations: Provide lead-free sight flow indicators from single manufacturer.
3. Description: Piping inline-installation device for visual verification of flow.
4. Construction: Lead-free bronze or stainless steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.
5. Minimum Pressure Rating: 150 psig.
6. Minimum Temperature Rating: 200 deg F.
7. End Connections: NPS 2 and smaller, threaded; NPS 2-1/2 and larger, flanged.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION OF EXPANSION JOINTS, GENERAL

- A. Install expansion joints of sizes matching sizes of piping in which they are installed.

#### 3.2 INSTALLATION OF PACKLESS EXPANSION JOINTS

- A. Install metal-bellows expansion joints in accordance with EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
- B. Install rubber packless expansion joints in accordance with FSA-PSJ-703.

#### 3.3 INSTALLATION OF GROOVED-JOINT EXPANSION JOINTS

- A. Install grooved-joint expansion joints to grooved-end steel piping.

### 3.4 INSTALLATION OF ALIGNMENT GUIDES AND ANCHORS

- A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.
- B. Install one guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.
- C. Attach guides to pipe, and secure guides to building structure.
- D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- E. Anchor Attachments:
  - 1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9.
  - 2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-58, Type 24; U bolts bolted to anchor.
- F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.
  - 1. Anchor Attachment to Steel Structural Members: Attach by welding.
  - 2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.
  - 3. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

### 3.5 INSTALLATION OF PIPE LOOP AND SWING CONNECTIONS

- A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
- B. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.
- C. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.

- D. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

### 3.6 INSTALLATION OF SLEEVES - GENERAL

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
  - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
  - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
  - 2. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
  - 3. Using grout, seal the space outside of sleeves in floors/slabs/walls without sleeve-seal system. Select to maintain fire resistance of floor/slab/wall.
- D. Install sleeves for pipes passing through interior partitions.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
  - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants that joint sealant manufacturer's literature indicates is appropriate for size, depth, and location of joint.
- E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

### 3.7 INSTALLATION OF SLEEVES WITH WATERSTOP

- A. Install sleeve with waterstop as new walls and slabs are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange centered across width of concrete slab or wall.
- C. Secure nailing flanges to wooden concrete forms.
- D. Using grout, seal space around outside of sleeves. Select to maintain fire resistance of floor/slab/wall.

### 3.8 INSTALLATION OF STACK-SLEEVE FITTINGS

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
  - 1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  - 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
  - 3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
  - 4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  - 5. Using silicone sealant, seal space between top hub of stack-sleeve fitting and pipe.
- B. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

### 3.9 INSTALLATION OF SLEEVE-SEAL SYSTEMS

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building, and passing through exterior walls.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

### 3.10 INSTALLATION OF ESCUTCHEONS

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

### 3.11 INSTALLATION OF METERS AND GAUGES

- A. Install thermometer with thermowell at each required thermometer location.
- B. Install thermowells in vertical position in piping tees.
- C. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- D. Install thermowells with extension on insulated piping.
- E. Fill thermowells with heat-transfer medium.
- F. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- G. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks.
- H. Install direct-mounted pressure gauges in piping tees with pressure gauge located on pipe at most readable position.
- I. Install remote-mounted pressure gauges on panel.
- J. Install valve and snubber in piping for each pressure gauge for fluids.
- K. Install test plugs in piping tees.
- L. Install thermometers in the following locations:
  - 1. Inlet and outlet of each water heater.

2. Inlets and outlets of each domestic water heat exchanger.
3. Inlet and outlet of each domestic hot-water storage tank.
4. Inlet and outlet of each remote domestic water chiller.
5. Outlet side of hot-water-balancing valve.
6. Each main hot-water-recirculating line return pipe.

M. Install pressure gauges in the following locations:

1. Building water service entrance into building.
2. Inlet and outlet of each pressure-reducing valve.
3. Suction and discharge of each domestic water pump.

### 3.12 CONNECTIONS

- A. Install meters and gauges adjacent to machines and equipment to allow space for service and maintenance of meters, gauges, machines, and equipment.

### 3.13 ADJUSTING

- A. After installation, calibrate meters according to manufacturer's written instructions.
- B. Adjust faces of meters and gauges to proper angle for best visibility.

### 3.14 FIELD QUALITY CONTROL

A. Sleeves and Sleeve Seals:

1. Perform the following tests and inspections:
  - a. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
  - b. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.
2. Prepare test and inspection reports.

B. Escutcheons:

1. Using new materials, replace broken and damaged escutcheons and floor plates.

### 3.15 SLEEVES APPLICATION

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
  - 1. Exterior Concrete Walls above and below Grade:
    - a. Sleeves with waterstops.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  - 2. Concrete Slabs-on-Grade:
    - a. Sleeves with waterstops.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  - 3. Concrete Slabs above Grade:
    - a. Sleeves with waterstops or stack-sleeve fittings.
  - 4. Interior Wall and Partitions:
    - a. Sleeves without waterstops.

### 3.16 ESCUTCHEONS APPLICATION

- A. Escutcheons for New Piping and Relocated Existing Piping:
  - 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
  - 2. Chrome-Plated Piping: One piece, cast brass with polished, chrome-plated finish.
  - 3. Insulated Piping:
    - a. One piece, cast brass with polished, chrome-plated finish.
  - 4. Bare Piping at Wall and Floor Penetrations in Finished Spaces:
    - a. One piece, cast brass with polished, chrome-plated finish.
  - 5. Bare Piping at Ceiling Penetrations in Finished Spaces:



- a. One piece, cast brass with polished, chrome-plated finish.
  - 6. Bare Piping in Unfinished Service Spaces:
    - a. One piece, cast brass with polished, chrome-plated finish.
  - 7. Bare Piping in Equipment Rooms:
    - a. One piece, cast brass with polished, chrome-plated finish.
  - B. Install floor plates for piping penetrations of equipment-room floors.
  - C. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
    - 1. New Piping and Relocated Existing Piping: One piece, floor plate.
- 3.17 THERMOMETER, LEAD FREE, APPLICATION
- A. Thermometers at inlet and outlet of each domestic water heater are to be the following:
    - 1. Metal case, industrial-style, liquid-in-glass type.
    - 2. Test plug with EPDM self-sealing rubber inserts.
  - B. Thermometer stems are to be of length to match thermowell insertion length.
- 3.18 THERMOMETER, LEAD FREE, SCALE-RANGE APPLICATION

- A. Scale Range for Domestic Cold-Water Piping:
  - 1. 0 to 150 deg F and minus 20 to plus 70 deg C.
- B. Scale Range for Domestic Hot-Water Piping:
  - 1. 0 to 250 deg F and 0 to 150 deg C.
- C. Insert additional paragraphs for thermometer scale ranges and applications.

### 3.19 PRESSURE-GAUGE APPLICATION

- A. Pressure gauges at discharge of each water service into building are to be the following:
  - 1. Solid front, pressure relief, direct mounted, metal case.
  - 2. Test plug with EPDM self-sealing rubber inserts.
- B. Pressure gauges at inlet and outlet of each water pressure-reducing valve are to be the following:
  - 1. Solid front, pressure relief, direct mounted, metal case.
  - 2. Test plug with EPDM self-sealing rubber inserts.
- C. Pressure gauges at suction and discharge of each domestic water pump are to be the following:
  - 1. Solid front, pressure relief, direct mounted, metal case.
  - 2. Test plug with EPDM self-sealing rubber inserts.

### 3.20 PRESSURE-GAUGE SCALE-RANGE APPLICATION

- A. Scale Range for Water Service Piping:
  - 1. 0 to 160 psi and 0 to 1100 kPa.
- B. Scale Range for Domestic Water Piping:

1. 0 to 160 psi and 0 to 1100 kPa.
- C. Insert additional paragraphs for pressure-gauge scale ranges and applications.

END OF SECTION 220500

## SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Ball valves.
2. Butterfly valves.
3. Check valves.
4. Gate valves.
5. Chainwheels.

#### 1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene-diene terpolymer.
- C. FKM: Fluoroelastomer.
- D. NBR: Nitrile butadiene rubber (also known as Buna-N).
- E. NRS: Nonrising stem.
- F. OS&Y: Outside screw and yoke.
- G. PTFE: Polytetrafluoroethylene.
- H. RPTFE: Reinforced polytetrafluoroethylene.
- I. RS: Rising stem.

#### 1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.
  - a. Include material descriptions and dimensions of individual components.
  - b. Include operating characteristics and furnished accessories.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooved ends, press ends, solder ends, and weld ends.
3. Set ball valves open to minimize exposure of functional surfaces.
4. Set butterfly valves closed or slightly open.
5. Block check valves in either closed or open position.
6. Set gate valves closed to prevent rattling.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems or other components as lifting or rigging points unless specifically indicated for this purpose in manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each type of valve from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Standards:

1. Domestic-water piping valves intended to convey or dispense water for human consumption must comply with the U.S. Safe Drinking Water Act (SDWA), requirements of authorities having jurisdiction, and NSF 61/NSF 372; or to be certified in compliance with NSF 61/NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
- B. ASME Compliance:
1. ASME B1.20.1 for threads for threaded-end valves.
  2. ASME B16.1 for flanges on iron valves.
  3. ASME B16.5 for flanges on steel valves.
  4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  5. ASME B16.18 for cast-copper solder-joint connections.
  6. ASME B16.22 for wrought-copper solder-joint connections.
  7. ASME B16.34 for flanged- and threaded-end connections.
  8. ASME B16.51 for press joint connections.
  9. ASME B31.9 for building services piping valves.
- C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.
- D. Provide bronze valves made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are unacceptable.
- E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- G. Valve Bypass and Drain Connections: MSS SP-45.
- H. Valve Actuator Type:
1. Gear Actuator: For quarter-turn ball valves NPS 4 and larger.
  2. Hand Lever: For quarter-turn ball valves smaller than NPS 4.

I. Valves in Insulated Piping:

1. Provide 2-inch extended neck stems.
2. Provide extended operating handles with nonthermal-conductive covering material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
3. Provide memory stops that are fully adjustable after insulation is applied.

2.3 BALL VALVES, LEAD FREE

A. Ball Valves, Lead Free, Press Ends - Bronze, Two Piece with Full Port and Bronze or Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - b. Hammond Valve.
  - c. Milwaukee Valve Company.
  - d. NIBCO INC.
  - e. Red-White Valve Corp.
  - f. Stockham; a Crane Co. brand.
  - g. Viega LLC.
  - h. Zurn Industries, LLC.
2. Standards: MSS SP-110, MSS SP-145, and IAPMO/ANSI Z1157.
3. CWP Rating: Minimum 200 psig.
4. Body Design: Two piece.
5. Body Material: Bronze.
6. Ends: Press.
7. Press-End Connections Rating: Minimum 200 psig.
8. Seats: PTFE or RTPFE.
9. Stem: Bronze or brass.
10. Ball: Chrome-plated brass.
11. Port: Full.
12. O-Ring Seal: EPDM or NBR.

B. Ball Valves, Lead Free, Threaded or Soldered Ends - Bronze, Two Piece with Full Port and Stainless Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - b. Milwaukee Valve Company.
  - c. NIBCO INC.

- d. Red-White Valve Corp.
  - e. Stockham; a Crane Co. brand.
  - f. Viega LLC.
  - g. WATTS; A Watts Water Technologies Company.
2. Standards: MSS SP-110 and MSS SP-145.
  3. CWP Rating: 600 psig.
  4. Body Design: Two piece.
  5. Body Material: Bronze.
  6. Ends: Threaded or soldered. See Part 3 ball valve schedule articles.
  7. Seats: PTFE.
  8. Stem: Stainless steel.
  9. Ball: Stainless steel, vented.
  10. Port: Full.

## 2.4 BALL VALVES, GENERAL PURPOSE

### A. Ball Valves, Threaded or Soldered Ends - Brass, Three Piece with Full Port and Stainless Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. DynaQuip Controls.
  - b. Marwin Valve; Richards Industries.
  - c. WATTS; A Watts Water Technologies Company.
2. Standard: MSS SP-110.
3. SWP Rating: 150 psig.
4. CWP Rating: 600 psig.
5. Body Design: Three piece.
6. Body Material: Forged brass.
7. Ends: Threaded or soldered. See Part 3 ball valve schedule articles.
8. Seats: PTFE.
9. Stem: Stainless steel.
10. Ball: Stainless steel, vented.
11. Port: Full.

## 2.5 BUTTERFLY VALVES, LEAD FREE

### A. Butterfly Valves, Lead Free, Single Flange (Lug Type) - Iron, with Stainless Steel Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - b. Hammond Valve.
  - c. Milwaukee Valve Company.
  - d. NIBCO INC.



- e. Red-White Valve Corp.
  - f. Stockham; a Crane Co. brand.
  - g. WATTS; A Watts Water Technologies Company.
  - h. Zurn Industries, LLC.
- 2. Standard: MSS SP-67, Type I.
  - 3. CWP Rating, NPS 12 (DN 300) and Smaller: 150 psig or 200 psig. See Part 3 butterfly valve schedule articles.
  - 4. Body Design: Single flange (lug type), suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
  - 5. Body Material: ASTM A126, cast iron or ASTM A536, ductile iron.
  - 6. Seat: EPDM or NBR. See Part 3 butterfly valve schedule articles.
  - 7. Stem: One- or two-piece stainless steel.
  - 8. Disc: Stainless steel.

## 2.6 BUTTERFLY VALVES, GENERAL PURPOSE

### A. Butterfly Valves, Single Flange (Lug Type) - Iron, with Stainless Steel Disc:

- 1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
- 2. Standard: MSS SP-67, Type I.
- 3. CWP Rating: 150 psig or 200 psig. See Part 3 butterfly valve schedule articles.
- 4. Body Design: Single flange (lug type), suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- 5. Body Material: ASTM A126, cast iron or ASTM A536, ductile iron.
- 6. Seat: NBR.
- 7. Stem: One- or two-piece stainless steel.
- 8. Disc: Stainless steel.

## 2.7 CHECK VALVES, LEAD FREE

### A. Check Valves, Lead Free, Swing Type, Threaded or Soldered Ends - Bronze, with Bronze Disc, Class 150:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - b. Hammond Valve.
  - c. Milwaukee Valve Company.
  - d. NIBCO INC.
  - e. Red-White Valve Corp.
  - f. Stockham; a Crane Co. brand.
- 2. Standard: MSS SP-80, Type 3.
- 3. CWP Rating: 300 psig.
- 4. Body Design: Horizontal flow.
- 5. Body Material: ASTM B62, bronze.
- 6. Ends: Threaded or soldered. See Part 3 check valve schedule articles.

7. Disc: Bronze.

B. Check Valves, Lead Free, Swing Type, Press Ends - Bronze:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - b. Hammond Valve.
  - c. Milwaukee Valve Company.
  - d. NIBCO INC.
2. Standards: MSS SP-80 and MSS SP-139.
3. CWP Rating: Minimum 200 psig.
4. Body Design: Horizontal flow.
5. Body Material: ASTM B584, bronze.
6. Ends: Press.
7. Press-End Connections Rating: Minimum 200 psig.
8. Disc: Brass or bronze.

C. Check Valves, Lead Free, Swing Type, Flanged Ends - Iron, with Lever- and Weight-Closure Control, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - b. Clow Valve Company; a subsidiary of McWane, Inc.
  - c. Kennedy Valve Company; a division of McWane, Inc.
  - d. Milwaukee Valve Company.
2. Standard: MSS SP-71, Type I.
3. CWP Rating: 200 psig.
4. Body Design: Clear or full waterway.
5. Body Material: ASTM A126, gray iron with bolted bonnet.
6. Ends: Flanged or threaded. See Part 3 check valve schedule articles.
7. Trim: Bronze.
8. Gasket: Asbestos free.
9. Closure Control: Factory-installed exterior lever and weight.

2.8 CHECK VALVES, GENERAL PURPOSE

A. Check Valves, Swing Type, Threaded or Soldered Ends - Bronze, with Bronze Disc, Class 150:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - b. Hammond Valve.
  - c. Milwaukee Valve Company.

- d. NIBCO INC.
    - e. Red-White Valve Corp.
    - f. Stockham; a Crane Co. brand.
  - 2. Standard: MSS SP-80, Type 3.
  - 3. CWP Rating: 300 psig.
  - 4. Body Design: Horizontal flow.
  - 5. Body Material: ASTM B62, bronze.
  - 6. Ends: Threaded or soldered ends. See Part 3 check valve schedule articles.
  - 7. Disc: Bronze.
- B. Check Valves, Swing Type, Flanged Ends - Iron, with Lever- and Weight-Closure Control, Class 125:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
    - b. Clow Valve Company; a subsidiary of McWane, Inc.
    - c. Kennedy Valve Company; a division of McWane, Inc.
    - d. Milwaukee Valve Company.
  - 2. Standard: MSS SP-71, Type I.
  - 3. CWP Rating, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): 200 psig.
  - 4. CWP Rating, NPS 14 to NPS 24 (DN 350 to DN 600): 150 psig.
  - 5. Body Design: Clear or full waterway.
  - 6. Body Material: ASTM A126, gray iron with bolted bonnet.
  - 7. Ends: Flanged.
  - 8. Trim: Bronze.
  - 9. Gasket: Asbestos free.
  - 10. Closure Control: Factory-installed, exterior lever and weight.

## 2.9 GATE VALVES, LEAD FREE

- A. Gate Valves, Lead Free, Flanged Ends - Iron, OS&Y, Class 125:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
    - b. Hammond Valve.
    - c. Kennedy Valve Company; a division of McWane, Inc.
    - d. Milwaukee Valve Company.
    - e. WATTS; A Watts Water Technologies Company.
    - f. Zurn Industries, LLC.
  - 2. Standard: MSS SP-70, Type I.
  - 3. CWP Rating: 200 psig.
  - 4. Body Material: Gray iron with bolted bonnet.
  - 5. Ends: Flange.

6. Trim: Bronze.
7. Disc: Solid wedge.
8. Packing and Gasket: Asbestos free.

## 2.10 CHAINWHEELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Babbitt Steam Specialty Co.
  2. Roto Hammer Industries; Rotork.
  3. Trumbull Industries.
- B. Description: Valve actuation assembly with sprocket rim, chain guides, chain, and attachment brackets for mounting chainwheels directly to handwheels.
  1. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve. Include zinc or epoxy coating.
  2. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Examine press fittings to verify they have been properly pressed.

- F. Do not attempt to repair defective valves; replace with new valves. Remove defective valves from site.

### 3.2 INSTALLATION OF VALVES

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Provide support of piping adjacent to valves such that no force is imposed upon valves.
- C. Locate valves for easy access and where not blocked by equipment, other piping, or building components.
- D. For valves in horizontal piping, install valves with stem at or above center of pipe.
- E. Install valves in position that does not project into aisles or block access to other equipment.
- F. Install valves in position to allow full stem and actuator or manual operator movement.
- G. Verify that joints of each valve have been properly installed and sealed to assure there is no leakage or damage.
- H. Chainwheels: Install chainwheels on manual operators for butterfly and gate valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.
- I. Install check valves for proper direction of flow and as follows:
  - 1. Check Valves: Center-guided type and plate type, in horizontal or vertical position, between flanges.
  - 2. Check Valves, Swing Type: In horizontal position with hinge pin level.
  - 3. Check Valves, Lift Type: With stem upright and plumb.
- J. Valve Tags: Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
- K. Adhere to manufacturer's written installation instructions. When soldering or brazing valves, do not heat valves above maximum permitted temperature. Do not use solder with melting point temperature above valve manufacturer's written recommended maximum.

### 3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

### 3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- B. Select valves with the following end connections:
  - 1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends except where solder-joint valve-end option or press-end option is indicated in valve schedules below.
  - 2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
  - 3. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
  - 4. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
  - 5. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged ends.
  - 6. For Grooved-End Steel Piping: Valve ends may be grooved.
  - 7. Wafer-Type Valves: Flanged connections.

### 3.5 LOW-PRESSURE, COMPRESSED-AIR BALL VALVE SCHEDULE - 150 PSIG (1035 kPa) OR LESS

- A. Pipe NPS 2 (DN 50) and Smaller:
  - 1. Ball valves threaded or soldered ends - brass, three pieces with full port and stainless steel trim.

### 3.6 DOMESTIC HOT- AND COLD-WATER BALL VALVE SCHEDULE

- A. Pipe NPS 2 (DN 50) and Smaller:
  - 1. Ball valves, lead free, threaded or soldered ends - bronze, two pieces with full port and stainless steel trim.
  - 2. Ball valves, lead free, press ends - bronze, two pieces with full port and bronze or brass trim.

### 3.7 LOW-PRESSURE, COMPRESSED-AIR BUTTERFLY VALVE SCHEDULE - 150 PSIG (1035 kPa) OR LESS

A. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Butterfly valves, single flange (lug type) - iron, with stainless steel disc; 200 CWP, NBR seat.

3.8 DOMESTIC HOT- AND COLD-WATER BUTTERFLY VALVE SCHEDULE

A. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Butterfly valves, lead free, single flange (lug type) - iron, with stainless steel disc; 200 CWP, EPDM seat.

3.9 LOW-PRESSURE, COMPRESSED-AIR CHECK VALVE SCHEDULE - 150 PSIG (1035 kPa) OR LESS

A. Pipe NPS 2 (DN 50) and Smaller:

1. Horizontal and Vertical Applications:
  - a. Check valves, swing type, threaded or soldered ends - bronze, with bronze disc, Class 150.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Check valves, swing type, flanged ends - iron, with metal seats, Class 125.

3.10 DOMESTIC HOT- AND COLD-WATER CHECK VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:

1. Check valves, lead free, swing type, threaded or soldered ends - bronze, with bronze disc, Class 150.

2. Check valves, lead free, swing type, press ends - bronze.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Check valves, lead free, swing type, flanged or threaded ends - iron, with metal seats, Class 125.

3.11 PUMP-DISCHARGE CHECK VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:

1. Check valves, lead free, swing type, threaded or soldered ends - bronze, with bronze disc, Class 125.

B. Pipe NPS 2-1/2 (DN 65) and Larger for Domestic Water Pumps:

1. Check valves, lead free, swing type, flanged or threaded ends - iron, with lever- and weight-closure control, Class 125.

3.12 DOMESTIC HOT- AND COLD-WATER GATE VALVE SCHEDULE

A. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Gate valves, lead free, flanged ends - iron, OS&Y, Class 125.

END OF SECTION 220523



## SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal hanger-shield inserts.
4. Fastener systems.
5. Pipe stands.
6. Equipment supports.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 220500 "Common Work Results for Plumbing."
3. Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment" for vibration isolation devices.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Pipe stands.
4. Equipment supports.

- C. Delegated Design Submittals: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 1. Detail fabrication and assembly of trapeze hangers.
  - 2. Include design calculations for designing trapeze hangers.

### 1.3 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

### 1.4 QUALITY ASSURANCE

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.
- B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.

- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
  - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
  - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

## 2.2 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
  - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  - 2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
  - 3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
  - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

## 2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

## 2.4 THERMAL HANGER-SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Buckaroos, Inc.
  - 2. Carpenter & Paterson, Inc.
  - 3. Rilco Manufacturing Co., Inc.
  - 4. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: ASTM C552, Type II cellular glass with 100-psig minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

## 2.5 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-carbon-steel shapes.

## 2.6 MATERIALS

- A. Aluminum: ASTM B221.
- B. Carbon Steel: ASTM A1011/A1011M.
- C. Structural Steel: ASTM A36/A36M carbon-steel plates, shapes, and bars; black and galvanized.
- D. Stainless Steel: ASTM A240/A240M.
- E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

### 3.2 INSTALLATION OF HANGERS AND SUPPORTS

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
  2. Field fabricate from ASTM A36/A36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- E. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- F. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- G. Install lateral bracing with pipe hangers and supports to prevent swaying.
- H. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms, and install reinforcing bars through openings at top of inserts.
- I. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- J. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- K. Insulated Piping:
1. Attach clamps and spacers to piping.
    - a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. MSS SP-58, Type 39: Install protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
  - a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
3. MSS SP-58, Type 40: Install protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
  - a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
  - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches long and 0.048 inch thick.
  - b. NPS 4 (DN 100): 12 inches long and 0.06 inch thick.
  - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches long and 0.06 inch thick.
  - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches long and 0.075 inch thick.
  - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

### 3.3 INSTALLATION OF EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment, and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### 3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

### 3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

### 3.6 PAINTING

- A. Touchup:
  1. Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
    - a. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
  2. Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in Division 9 Painting Specification.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

### 3.7 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.

- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers, and metal framing systems and attachments for general service applications.
- F. Use stainless steel pipe hangers and stainless-steel attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper or stainless steel attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal hanger-shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
  - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
  - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
  - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
  - 5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
  - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
  - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  - 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  - 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
  - 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
  - 12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
  - 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  - 14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
  - 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.



16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
  17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction occurs.
  18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction occurs.
  19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction occurs but vertical adjustment is unnecessary.
  20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction occurs and vertical adjustment is unnecessary.
  21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation, in addition to expansion and contraction, is required.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment of up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11 split pipe rings.
  4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.

8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
  12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
  13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
  2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
  3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
  4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
  5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
  6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
  7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
  8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

- a. Horizontal (MSS Type 54): Mounted horizontally.
  - b. Vertical (MSS Type 55): Mounted vertically.
  - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- P. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- R. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

## SECTION 220533 - HEAT TRACING FOR PLUMBING PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes heat tracing of plumbing piping for freeze prevention with self-regulating, parallel-resistance electric heating cables:
- B. Related Requirements:
  - 1. Section 230533 "Heat Tracing for HVAC Piping."

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include rated capacities, operating characteristics, and furnished specialties and accessories.
  - 2. Schedule heating capacity, length of cable, spacing, and electrical power requirement for each electric heating cable required.
- B. Shop Drawings: For electric heating cable.
  - 1. Include plans, elevations, sections, and attachment details.
  - 2. Include diagrams for power, signal, and control wiring.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Sample warranties.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For electric heating cables and controls to include in operation and maintenance manuals.

#### 1.5 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Chromalox, Inc.
  - 2. Nelson; Emerson Electric Co., Automation Solutions.
  - 3. RAYCHEM; brand of nVent Electrical plc.
  - 4. Thermon, Inc.
- B. Source Limitations: Obtain all heat tracing from one manufacturer.
- C. Standard: IEEE 515.1.

- D. Heating Element: Pair of parallel No. 16 AWG, tinned or nickel-coated, stranded copper bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to temperature along its length.
- E. Electrical Insulating Jacket: Flame-retardant polyolefin.
- F. Grounding Cover: Copper or Tinned-copper braid.
- G. Cable Cover: Polyolefin outer jacket with ultraviolet inhibitor.
- H. Terminate cable with waterproof, factory-assembled, nonheating leads with connectors at one end, and seal the opposite end watertight. Cable is to be capable of crossing over itself once without overheating.
- I. Maximum Operating Temperature (Power On): 150 deg F.
- J. Maximum Exposure Temperature (Power Off): 185 deg F.
- K. 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.
- L. Capacities and Characteristics:
  - 1. Maximum Heat Output: 8 W/ft..
  - 2. Piping Diameter: 4 NPS.
  - 3. Electrical Characteristics for Single-Circuit Connection:
    - a. Volts: 208 V.
    - b. Phase: 3.
    - c. Hertz: 60 Hz.
    - d. Full-Load Amperes: <Insert number> A.
    - e. Minimum Circuit Ampacity: <Insert number> A.
    - f. Maximum Overcurrent Protection: <Insert number> A.

## 2.2 CONTROLS

A. Pipe-Mounted Thermostats for Freeze Protection:

1. Remote bulb temperature control unit with adjustable range from 30 to 50 deg F.
2. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected cable.
3. Remote temperature-sensing bulb on capillary, resistance temperature device, or thermistor for directly sensing outside air or pipe-wall temperature.
4. Corrosion-resistant, waterproof control enclosure.

B. Control Panel:

1. Microprocessor-based control with manual on, automatic, and standby/reset switch.
2. Remote temperature sensor senses outside air temperature; programmable to energize the freeze-protection cable when temperature falls below 34 to 44 deg F.
3. Corrosion-proof and waterproof enclosure suitable for outdoor mounting, for controls and temperature sensors.
4. Minimum 30 A contactor to energize cable or close other contactors.
5. Ground-fault protection.
6. Single-point control of heat tracing for freeze protection.
7. Provide communication ports with contacts, RS485, or Ethernet interface for remote monitoring and alarm by central HVAC-control system. Coordinate type of connection ports with Section 230923 "Direct Digital Control (DDC) System for HVAC."

2.3 ACCESSORIES

- A. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.
- B. Warning Labels: See Section 220553 "Identification for Plumbing Piping and Equipment."
- C. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least 3 mils thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.
1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.

2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.
  1. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Install electric heating cable at locations indicated and in accordance with NFPA 70.
- B. Install electric heating cable across expansion, construction, and control joints in accordance with manufacturer's written instructions; use cable-protection conduit and slack cable to allow movement without damage to cable.
- C. Install electric heating cables after piping has been tested and before insulation is installed.
- D. Install electric heating cables in accordance with IEEE 515.1.
- E. Install insulation over piping with electric cables in accordance with Section 220719 "Plumbing Piping Insulation."
- F. Install warning tape on piping insulation where piping is equipped with electric heating cables.
- G. Set field-adjustable switches and circuit-breaker trip ranges.
- H. Install temperature-control units in an accessible location and in accordance with manufacturer's written instructions. Locate sensing bulbs to sense outside air temperature in a location where it will not be affected by direct sunlight or other heat sources.
- I. Install control panels and distribution panels where indicated and in accordance with manufacturer's written instructions.
- J. Install and connect outside air and pipe temperature sensors.



### 3.3 ELECTRICAL CONNECTIONS

- A. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Connect temperature-control unit for freeze protection to interrupt power supply to electric heating cable when outside air is above set point.
- D. Connect temperature-control unit for domestic hot-water-temperature maintenance to interrupt power supply to electric heating cable when hot water is above set point.
- E. Connect remote electronic temperature sensors.

### 3.4 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 with the assistance of a factory-authorized service representative:
  - 1. Perform tests after cable installation but before application of coverings, such as insulation, wall or ceiling construction, or concrete.
  - 2. Test cables for electrical continuity and insulation integrity before energizing.
  - 3. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.
- D. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounted cables.
- E. Cables will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.

3.5 PROTECTION

- A. Protect installed heating cables, including nonheating leads, from damage.
- B. Remove and replace damaged heat-tracing cables.

END OF SECTION 220533

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## SECTION 220548 - VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

### **TIPS:**

To view non-printing **Editor's Notes** that provide guidance for editing, click on MasterWorks/Single-File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination checklists**, click on MasterWorks/Supporting Information.

### **Content Requests:**

[<Double click here to submit questions, comments, or suggested edits to this Section.>](#)

Use this Section if Project is in a seismic area. Use Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment" for projects not in a seismic area.

Revise this Section by deleting and inserting text to meet Project-specific requirements.

This Section uses the term "Architect." Change this term to match that used to identify the design professional as defined in the General and Supplementary Conditions.

Verify that Section titles referenced in this Section are correct for this Project's Specifications; Section titles may have changed.

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

Retain or delete this article in all Sections of Project Manual.

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

### 1.2 SUMMARY

- A. Section Includes:
  - 1. Elastomeric isolation pads.
  - 2. Elastomeric isolation mounts.
  - 3. Restrained elastomeric isolation mounts.
  - 4. Open-spring isolators.

5. Housed-spring isolators.
6. Restrained-spring isolators.
7. Housed-restrained-spring isolators.
8. Pipe-riser resilient support.
9. Resilient pipe guides.
10. Air-spring isolators.
11. Restrained-air-spring isolators.
12. Elastomeric hangers.
13. Spring hangers.
14. Snubbers.
15. Restraints - rigid type.
16. Restraints - cable type.
17. Restraint accessories.
18. Post-installed concrete anchors.
19. Concrete inserts.
20. Vibration isolation equipment bases.

B. Related Requirements:

Retain subparagraphs below to cross-reference requirements Contractor might expect to find in this Section but are specified in other Sections.

1. Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment" for devices for fire-suppression equipment and systems.
2. Section 230548 "Vibration and Seismic Controls for HVAC" for devices for HVAC equipment and systems.

1.3 DEFINITIONS

Retain terms that remain after this Section has been edited for a project.

- A. Designated Seismic System: A plumbing component that requires design in accordance with ASCE/SEI 7, Ch. 13 and for which the Component Importance Factor is greater than 1.0.
- B. IBC: International Building Code.
- C. OSHPD: Office of Statewide Health Planning and Development (for the State of California owned and regulated medical facilities).

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.

Retain first subparagraph below if wind-load design services have been delegated to Contractor.

2. Include load rating for each wind-load-restraint fitting and assembly.
3. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component.

See the Evaluations for a discussion on seismic-restraint capacities and rating services. Retain all options in first subparagraph below that apply.

4. Annotate types and sizes of seismic restraints and accessories, complete with listing markings or report numbers and load rating in tension and compression as evaluated by UL product listing.
5. Annotate to indicate application of each product submitted and compliance with requirements.
6. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Shop Drawings:

1. Detail fabrication and assembly of equipment bases.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

Retain "Delegated Design Submittal" Paragraph below if design services have been delegated to Contractor.

C. Delegated Design Submittal:

1. For each seismic-restraint device, including seismic-restrained mounting, pipe-riser resilient support, snubber, seismic restraint, seismic-restraint accessory, and concrete anchor and insert that is required by this Section or is indicated on Drawings, submit the following:
  - a. Seismic- and Wind-Load- Restraint Selection: Select seismic restraints complying with performance requirements, design criteria, and analysis data.
  - b. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, and seismic loads. Include certification by professional engineer that riser system was examined for excessive stress and that none exists.
  - c. Post-Installed Concrete Anchors and Inserts: Include calculations showing anticipated seismic loads. Include certification that device is approved by an NRTL for seismic reinforcement use.

Retain "Seismic Design Calculations" Subparagraph below if seismic design services have been delegated to Contractor.

- d. Seismic Design Calculations: Submit all input data and loading calculations prepared under "Seismic Design Calculations" Paragraph in "Performance Requirements" Article.
- e. Qualified Professional Engineer: All designated-design submittals for seismic calculations are to be signed and sealed by qualified professional engineer responsible for their preparation.

Retain first subparagraph below only if design requirements apply but calculations have not been made and details or charts on Drawings do not describe seismic or wind restraints in detail. Retaining below requires Contractor to submit seismic-restraint delegated design Drawings prepared by a professional engineer. Revise to suit Project requirements.

2. Seismic- Restraint Detail Drawing:

- a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
- b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.

Retain first subparagraph below if Project includes equipment mounted outdoors or otherwise subject to wind loading.

- c. Coordinate seismic restraint details with wind-load restraint details required for equipment mounted outdoors. Comply also with requirements in other Sections for equipment mounted outdoors.
  3. Product Listing, Preapproval, and Evaluation Documentation: By UL, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
  4. All delegated design submittals for seismic-restraint detail Drawings are to be signed and sealed by qualified professional engineer responsible for their preparation.
- D. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, and seismic loads. Include certification that riser system was examined for excessive stress and that none exists.

## 1.5 INFORMATIONAL SUBMITTALS

Retain "Coordination Drawings" Paragraph below for situations where limited space necessitates maximum utilization for efficient installation of different components or if coordination is required for installation of products and materials by separate installers. Coordinate paragraph with other Sections specifying products listed below. Preparation of coordination drawings requires the participation of each trade involved in installations within the limited space.

- A. Coordination Drawings: Show coordination of seismic bracing for fire-suppression piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

Coordinate "Qualification Data" Paragraph below with qualification requirements in Section 014000 "Quality Requirements" and as may be supplemented in "Quality Assurance" Article.

- B. Qualification Data: For professional engineer and testing agency.

Retain "Welding certificates" Paragraph below if retaining "Welding Qualifications" Paragraph in "Quality Assurance" Article.

- C. Welding certificates.

Retain "Field quality-control reports" Paragraph below if Contractor is responsible for field quality-control testing and inspecting.

- D. Field quality-control reports.

Retain "Seismic Qualification Data" Paragraph below in "Informational Submittals" Article of all Specification Sections that specify Designated Seismic Systems, or as required by authorities having jurisdiction.

See "Special Certification" Article in the Evaluations for a discussion on certification and see Paragraph 13.2.2 of ASCE/SEI 7-05, ASCE/SEI 7-10, or ASCE/SEI 7-16 for specific requirements. Fire-suppression system engineer must identify all equipment and systems required to have special certification. These must be identified in Equipment Schedule or separate Vibration Isolation, Seismic, and Wind-Load-Restraints Schedule; or, if the number of devices and systems is small, they can be listed in the Specifications.

- E. Seismic Qualification Data: Provide special certification for designated seismic systems as indicated in ASCE/SEI 7-16, Paragraph 13.2.2, "Special Certification Requirements for Designated Seismic Systems" for all Designated Seismic Systems identified as such on Drawings or in the Specifications.
  - 1. Provide equipment manufacturer's written certification for each designated active fire-suppression system seismic device and system, stating that it will remain operable following the design earthquake. Certification must be based on requirements of ASCE/SEI 7 and AHRI 1270, including shake table testing per ICC-ES AC156 or a similar nationally recognized testing standard procedure acceptable to authorities having jurisdiction ASCE/SEI 7-16.
  - 2. Provide equipment manufacturer's written certification that components with hazardous contents maintain containment following the design earthquake by methods required in ASCE/SEI 7-16.
  - 3. Submit evidence demonstrating compliance with these requirements for approval to authorities having jurisdiction after review and acceptance by a licensed professional engineer.

Retain "Wind-Load Performance Certification" Paragraph below in "Informational Submittals" Article of all Specification Sections that specify fire-suppression system equipment requiring wind-load certification.

## 1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Seismic-Restraint Device Load Ratings: Devices to be tested and rated in accordance with applicable code requirements and authorities having jurisdiction. Devices to be listed by a nationally recognized third party that requires periodic follow-up inspections and has a listing directory available to the public. Provide third-party listing by one or more of the following: UL product listing.

## PART 2 - PRODUCTS

Manufacturers and products listed in SpecAgent and MasterWorks Paragraph Builder are neither recommended nor endorsed by the AIA or Deltek. Before inserting names, verify that manufacturers and products listed there comply with requirements retained or revised in descriptions and are both available and suitable for the intended applications. For definitions of terms and requirements for Contractor's product selection, see Section 016000 "Product Requirements."

See the Evaluations for more detailed information about controlling vibration and seismic damage, additional information on products described in this Section and supplements to Equipment Schedules.

Coordinate specifications for products in this Section with Project structural engineer and with Drawings.

### 2.1 PERFORMANCE REQUIREMENTS

Retain "Delegated Design" Paragraph below if Contractor is required to assume responsibility for design.

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design seismic control system.

Retain "Seismic( and Wind-Load) Performance" Subparagraph below for projects requiring seismic design. Delete below if performance requirements are indicated on Drawings. Model building codes and ASCE/SEI 7 establish criteria for buildings subject to earthquake motions. Coordinate requirements with structural engineer.

- 1. Seismic Performance: Equipment shall withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7-16.

Retain "Seismic Design Calculations" Paragraph and applicable calculation factors subparagraph below if seismic design services have been delegated to Contractor.

- B. Seismic Design Calculations:

ASCE/SEI 7 is generally applicable in most locations, but it is plumbing engineer's responsibility to determine the applicable building codes and editions thereof, and applicable seismic design standards that apply to Project. Data and information required for seismic calculations in ASCE/SEI 7 are listed below. ASCE/SEI 7-05, ASCE/SEI 7-10, and ASCE/SEI 7-16 differ somewhat; criteria from all three editions have been included below and have been noted. Plumbing engineer must delete all non-applicable edition references throughout this Section.

If a calculation method other than that prescribed in any edition of ASCE/SEI 7 is applicable to Project, plumbing engineer must revise the Section Text to provide alternative appropriate calculation parameters and instructions for delegated designer in lieu of those given below.

- 1. Perform calculations to obtain force information necessary to properly select seismic-restraint devices, fasteners, and anchorage. Perform calculations using methods acceptable to applicable code authorities and as presented in ASCE/SEI 7-16. Where "ASCE/SEI 7" is used throughout this Section, it is to be understood that the edition referred to in this subparagraph is the edition intended as reference throughout the section text.



- a. Data indicated below to be determined by Delegated-Design Contractor must be obtained by Contractor and must be included in individual component submittal packages.

The term "Building Risk Category" is used in ASCE/SEI 7-10 and ASCE/SEI 7-16. Plumbing engineer must obtain the value from Project structural engineer and retain first subparagraph below.

- b. Building Risk Category: IV.

The "Building Site Classification" value must be obtained by plumbing engineer from Project structural engineer and retain first subparagraph below.

- c. Building Site Classification: C.

Retain "Calculation Factors, ASCE/SEI 7-16, Ch. 13 - Seismic Design Requirements for Nonstructural Components" Subparagraph below if ASCE/SEI 7-16 applies to this Project.

1. Calculation Factors, ASCE/SEI 7-16, Ch. 13 - Seismic Design Requirements for Nonstructural Components: All section, paragraph, equation, and table numbers refer to ASCE/SEI 7-16 unless otherwise noted.
  - a. Horizontal Seismic Design Force  $F_p$ : Value is to be calculated by Delegated Design Contractor using Equation 13.3-1. Factors below must be obtained for this calculation:

"Spectral Acceleration" value applies to all components on Project. Value is to be obtained by fire-suppression system engineer from Project structural engineer based on ASCE/SEI 7-16 Section 11.4.5.

- 1)  $S_{DS}$  = Spectral Acceleration: 0.296. Value applies to all components on Project.

"Component Amplification Factor" for each component is selected by fire-suppression system engineer as explained in ASCE/SEI 7-16 Section 13.6.1. List on Drawing Schedule for each component.

- 2)  $a_p$  = Component Amplification Factor: See Drawing Schedule for each component.

"Component Importance Factor" is assigned by fire-suppression system engineer as explained in ASCE/SEI 7-16 Section 13.1.3. List on Drawing Schedule for each component.

- 3)  $I_p$  = Component Importance Factor: See Drawing Schedule for each component.
- 4)  $W_p$  = Component Operating Weight: For each component. Obtain by Delegated Design Contractor from each component submittal.

"Component Response Modification Factor" is selected by fire-suppression system engineer from ASCE/SEI 7-16, Table 13.6-1. List on Drawing Schedule for each component.

- 5)  $R_p$  = Component Response Modification Factor: See Drawing Schedule for each component.
- 6)  $z$  = Height in Structure of Point of Attachment of Component for Base: Determine from Project Drawings for each component by Delegated Design Contractor. For items at or below the base, "z" is to be taken as zero.

- 7)  $h$  = Average Roof Height of Structure for Base: Determine from Project Drawings by Delegated Design Contractor.
- b. Vertical Seismic Design Force: Calculated by Delegated Design Contractor using method explained in ASCE/SEI 7-16, Paragraph 13.3.1.2.
- c. Seismic Relative Displacement  $D_{pl}$ : Calculated by Delegated Design Contractor using methods explained in ASCE/SEI 7-16, Paragraph 13.3.2. Factors below must be obtained for this calculation:
  - 1)  $D_p$  = Relative Seismic Displacement that Each Component Must Be Designed to Accommodate: Calculated by Delegated Design Contractor in accordance with ASCE/SEI 7-16, Paragraph 13.3.2.

"Structure Importance Factor" is assigned by fire-suppression system engineer from Project structural engineer and ASCE/SEI 7-16 Section 11.5.1.

- 2)  $I_e$  = Structure Importance Factor: 1.5. Value applies to all components on Project.

"Deflection at building level x of Structure A" value is determined for each component in building in accordance with ASCE/SEI 7-16, Equation 12.8-15 and depends upon location of component in the building. Value is obtained by fire-suppression system engineer from Project structural engineer.

- 3)  $\delta_{xA}$  = Deflection at Building Level x of Structure A: See Drawing Schedule for each component.

"Deflection at building level y of Structure A" value is determined for each component in building in accordance with ASCE/SEI 7-16, Equation 12.8-15 and depends upon location of component in the building. Value is obtained by fire-suppression system engineer from Project structural engineer.

- 4)  $\delta_{yA}$  = Deflection at Building Level y of Structure A: See Drawing Schedule for each component.

"Deflection at building level y of Structure B" value is determined for each component in building in accordance with ASCE/SEI 7-16, Equation 12.8-15 and depends upon location of component in the building. Value is obtained by fire-suppression system engineer from Project structural engineer.

- 5)  $\delta_{yB}$  = Deflection at Building Level y of Structure B: See Drawing Schedule for each component.
- 6)  $h_x$  = Height of Level x to which Upper Connection Point Is Attached: Determine for each component by Delegated Design Contractor from Project Drawings and manufacturer's data.
- 7)  $h_y$  = Height of Level y to which Upper Connection Point Is Attached: Determine for each component by Delegated Design Contractor from Project Drawings and manufacturer's data.

"Allowable story drift for Structure A" value is determined in accordance with ASCE/SEI 7-16, Equation 12.12-1 and depends upon location of component in the building. Value is obtained by fire-suppression system engineer from Project structural engineer.

- 8)  $\Delta_{aA}$  = Allowable Story Drift for Structure A: See Drawing Schedules for each component.

"Allowable story drift for Structure B" value is determined in accordance with ASCE/SEI 7-16, Equation 12.12-1 and depends upon location of component in the building. Value is obtained by fire-suppression system engineer from Project structural engineer.

- 9)  $\Delta_{aB}$  = Allowable Story Drift for Structure B: See Drawing Schedules for each component.

"Story Height" used in the definition of the "allowable drift" value is determined in accordance with ASCE/SEI 7-16, Table 12.12-1 and depends upon location of component in the building. Value is obtained by fire-suppression system engineer from Project structural engineer.

- 10)  $h_{sx}$  = Story Height Used in the Definition of the Allowable Drift  $\Delta_a$ : See Drawings Schedules for each component.

- d. Component Fundamental Period  $T_p$ : Calculated by Delegated Design Contractor using methods explained in ASCE/SEI 7-16, Paragraph 13.3.3. Factors below must be obtained for this calculation:

- 1)  $W_p$  = Component Operating Weight: Determined by contractor from Project Drawings and manufacturer's data.
- 2)  $g$  = Gravitational Acceleration: 32.17 fps<sup>2</sup>.
- 3)  $K_p$  = Combined Stiffness of Component, Supports, and Attachments: Determined by delegated design seismic engineer.

Retain "Calculation Factors, ASCE/SEI 7-10, Ch. 13 - Seismic Design Requirements for Nonstructural Components" Subparagraph below if ASCE/SEI 7-10 applies to this Project.

Retain "Calculation Factors, ASCE/SEI 7-05, Ch. 13 - Seismic Design Requirements for Nonstructural Components" Subparagraph below if ASCE/SEI 7-05 applies to this Project.

Retain "Wind-Load Design Calculations" Paragraph and applicable calculation factors subparagraph below if wind-load reinforcement design services have been delegated to Contractor.

- C. Consequential Damage: Provide additional seismic and wind-load restraints for suspended fire-suppression system components or anchorage of floor-, roof-, or wall-mounted fire-suppression system components as indicated in ASCE/SEI 7-16 so that failure of a non-essential or essential fire-suppression system component will not cause the failure of any other essential architectural, mechanical, or electrical building component.
- D. Fire/Smoke Resistance: Seismic-restraint devices that are not constructed of ferrous metals must have a maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested by an NRTL in accordance with ASTM E84 or UL 723, and be so labeled.
- E. Component Supports:
  1. Load ratings, features, and applications of all reinforcement components must be based on testing standards of a nationally recognized testing agency.
  2. All component support attachments must comply with force and displacement resistance requirements of ASCE/SEI 7-16 Section 13.6.

## 2.2 ELASTOMERIC ISOLATION PADS

Copy "Elastomeric Isolation Pads" Paragraph below and re-edit for each product.

Configuration and materials of elastomeric isolation pads depend on the equipment being supported. It is possible to have more than one type of elastomeric isolation pad on same Project. Insert Drawing designation. Use these designations on Drawings to identify each product.

### A. Elastomeric Isolation Pads: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. CADDY; brand of nVent Electrical plc.
  - b. California Dynamics Corporation.
  - c. Kinetics Noise Control, Inc.
  - d. Mason Industries, Inc.
  - e. VMC GROUP.
2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
3. Size: Factory or field cut to match requirements of supported equipment.
4. Pad Material: Oil and water resistant with elastomeric properties. Neoprene rubber, silicone rubber, or other elastomeric material.
5. Surface Pattern: Smooth, ribbed, or waffle pattern.

Retain first subparagraph below if pad is infused with synthetic fibers.

6. Infused nonwoven cotton or synthetic fibers.

Retain first subparagraph below if galvanized-steel baseplates are adhered to isolation pad to facilitate load distribution.

7. Load-bearing metal plates adhered to pads.

Retain "Sandwich-Core Material" Subparagraph below if pad has a sandwich-core material.

Copy below and re-edit for each sandwich-core material. Core materials may not be elastomeric. See "Elastomeric Isolation Pads" Article in the Evaluations for more information.

8. Sandwich-Core Material: Resilient and elastomeric.

Retain "Surface Pattern" Subparagraph below if the sandwich-core material has a surface pattern.

- a. Surface Pattern: Smooth, ribbed, or waffle pattern.

Retain subparagraph below if pad is infused with synthetic fibers.

- b. Infused nonwoven cotton or synthetic fibers.

## 2.3 ELASTOMERIC ISOLATION MOUNTS

Copy "Double-Deflection, Elastomeric Isolation Mounts" Paragraph below and re-edit for each product.

Configuration and materials of elastomeric isolation mounts depend on the equipment being supported. It is possible to have more than one type of elastomeric isolation mount on same Project. Insert drawing designation. Use these designations on Drawings to identify each product.

A. Double-Deflection, Elastomeric Isolation Mounts: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. CADDY; brand of nVent Electrical plc.
  - b. California Dynamics Corporation.
  - c. Kinetics Noise Control, Inc.
  - d. Mason Industries, Inc.
  - e. VMC GROUP.
2. Mounting Plates:
  - a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.

Retain "Baseplate" Subparagraph below if the elastomeric mount being specified has a baseplate.

- b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
3. Elastomeric Material: Molded, oil- and water-resistant neoprene rubber, silicone rubber, or other elastomeric material.

## 2.4 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

Copy "Restrained Elastomeric Isolation Mounts" Paragraph below and re-edit for each product.

Configuration and materials of restrained elastomeric isolation mounts depend on the equipment being supported. It is possible to have more than one type of restrained elastomeric isolation mount on same Project. Insert drawing designation. Use these designations on Drawings to identify each product.

A. Restrained Elastomeric Isolation Mounts: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. CADDY; brand of nVent Electrical plc.
  - b. California Dynamics Corporation.
  - c. Kinetics Noise Control, Inc.
  - d. Mason Industries, Inc.
  - e. VMC GROUP.
2. Description: All-directional isolator with seismic restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
  - a. Housing: Cast-ductile iron or welded steel.

- b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

## 2.5 OPEN-SPRING ISOLATORS

Copy "Freestanding, Laterally Stable, Open-Spring Isolators" Paragraph below and re-edit for each product.

Configuration and materials of open-spring isolators depend on the equipment being supported. It is possible to have more than one type of open-spring isolator on same Project. Insert drawing designation. Use these designations on Drawings to identify each product.

### A. Freestanding, Laterally Stable, Open-Spring Isolators: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. CADDY; brand of nVent Electrical plc.
  - b. California Dynamics Corporation.
  - c. Kinetics Noise Control, Inc.
  - d. Mason Industries, Inc.
  - e. VMC GROUP.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig.
7. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

## 2.6 HOUSED-SPRING ISOLATORS

Copy "Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing" Paragraph below and re-edit for each product.

Configuration and materials of housed-spring isolators depend on the equipment being supported. It is possible to have more than one type of housed-spring isolator on same Project. Insert drawing designation. Use these designations on Drawings to identify each product.

### A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. CADDY; brand of nVent Electrical plc.
  - b. California Dynamics Corporation.
  - c. Kinetics Noise Control, Inc.
  - d. Mason Industries, Inc.
  - e. VMC GROUP.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.
  - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
  - b. Top housing with threaded mounting holes and internal leveling device.

## 2.7 RESTRAINED-SPRING ISOLATORS

Copy "Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint" Paragraph below and re-edit for each product.

Configuration and materials of restrained-spring isolators depend on the equipment being supported. It is possible to have more than one type of restrained-spring isolator on same Project. Insert drawing designation. Use these designations on Drawings to identify each product.

### A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. CADDY; brand of nVent Electrical plc.
  - b. California Dynamics Corporation.
  - c. Kinetics Noise Control, Inc.
  - d. Mason Industries, Inc.
  - e. VMC GROUP.
2. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
  - a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
  - b. Top plate with threaded mounting holes.
  - c. Internal leveling bolt that acts as blocking during installation.
3. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
5. Minimum Additional Travel: 50 percent of the required deflection at rated load.

6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

## 2.8 HOUSED-RESTRAINED-SPRING ISOLATORS

Copy "Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing" Paragraph below and re-edit for each product.

Configuration and materials of housed-restrained-spring isolators depend on the equipment being supported. It is possible to have more than one type of housed-restrained-spring isolator on same Project. Insert drawing designation. Use these designations on Drawings to identify each product.

- A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing: .
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CADDY; brand of nVent Electrical plc.
    - b. California Dynamics Corporation.
    - c. Kinetics Noise Control, Inc.
    - d. Mason Industries, Inc.
    - e. VMC GROUP.
  2. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.
    - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
    - b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.
  3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

## 2.9 PIPE-RISER RESILIENT SUPPORT

Copy "Description" Paragraph below and re-edit for each product.

Configuration and materials of pipe-riser resilient supports depend on the equipment being supported. It is possible to have more than one type of pipe-riser resilient support on same Project. Insert drawing designation. Use these designations on Drawings to identify each product.



- A. All-Directional, Acoustical Pipe Anchor Consisting of Two Steel Tubes Separated by a Minimum 1/2-inch-Thick Neoprene: .
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CADDY; brand of nVent Electrical plc.
    - b. California Dynamics Corporation.
    - c. Kinetics Noise Control, Inc.
    - d. Mason Industries, Inc.
    - e. VMC GROUP.
  2. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
  3. Maximum Load Per Support: 500 psig on isolation material providing equal isolation in all directions.

## 2.10 RESILIENT PIPE GUIDES

Copy "Telescopic Arrangement of Two Steel Tubes or Post and Sleeve Arrangement Separated by a Minimum 1/2-inch- (13-mm-) Thick Neoprene" Paragraph below and re-edit for each product.

Configuration and materials of resilient pipe guides depend on the equipment being supported. It is possible to have more than one type of resilient pipe guide on same Project. Insert drawing designation. Use these designations on Drawings to identify each product.

- A. Telescopic Arrangement of Two Steel Tubes or Post and Sleeve Arrangement Separated by a Minimum 1/2-inch-Thick Neoprene: .
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CADDY; brand of nVent Electrical plc.
    - b. California Dynamics Corporation.
    - c. Kinetics Noise Control, Inc.
    - d. Mason Industries, Inc.
    - e. VMC GROUP.

Retain "Factory-Set Height Guide with Shear Pin" Subparagraph below where vertical motion due to pipe expansion and contraction is required and clearances are not readily visible.

2. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

## 2.11 ELASTOMERIC HANGERS

Copy "Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods" Paragraph below and re-edit for each product.

Configuration and materials of elastomeric hangers depend on the equipment being supported. It is possible to have more than one type of elastomeric hanger on same Project. Insert drawing designation. Use these designations on Drawings to identify each product.

A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. CADDY; brand of nVent Electrical plc.
  - b. California Dynamics Corporation.
  - c. Kinetics Noise Control, Inc.
  - d. Mason Industries, Inc.
  - e. VMC GROUP.
2. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
3. Damping Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel-to-steel contact.

2.12 SPRING HANGERS

Copy "Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression" Paragraph below and re-edit for each product.

Configuration and materials of spring hangers depend on the equipment being supported. It is possible to have more than one type of spring hanger on same Project. Insert drawing designation. Use these designations on Drawings to identify each product.

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. CADDY; brand of nVent Electrical plc.
  - b. California Dynamics Corporation.
  - c. Kinetics Noise Control, Inc.
  - d. Mason Industries, Inc.
  - e. VMC GROUP.
2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.

Retain "Adjustable Vertical Stop" Subparagraph below if a vertical-limit stop is required.

8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
9. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

## 2.13 SNUBBERS

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. CADDY; brand of nVent Electrical plc.
  - b. California Dynamics Corporation.
  - c. Kinetics Noise Control, Inc.
  - d. Mason Industries, Inc.
  - e. VMC GROUP.
- B. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
  1. Post-installed Concrete Anchor Bolts: Secure to concrete surface with post-installed concrete anchors. Anchors to be seismically prequalified in accordance with ACI 355.2 testing and designated in accordance with ACI 318-14 Ch. 17 for 2015 or 2018 IBC. Preset concrete inserts: Seismically prequalified in accordance with ICC-ES AC446 testing.
  2. Anchors in Masonry: Design in accordance with TMS 402.
  3. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
  4. Resilient Cushion: Maximum 1/4-inch air gap, and minimum 1/4 inch thick.

## 2.14 RESTRAINTS - RIGID TYPE

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. CADDY; brand of nVent Electrical plc.
  - b. California Dynamics Corporation.
  - c. Kinetics Noise Control, Inc.
  - d. Mason Industries, Inc.
  - e. VMC GROUP.
- B. Description: Shop- or field-fabricated bracing assembly made of ANSI/AISI S110-07-S1 slotted steel channels, ANSI/ASTM A53/A53M steel pipe as per NFPA 13, or other rigid steel brace member. Includes accessories for attachment to braced component at one end and to building

structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

## 2.15 RESTRAINTS - CABLE TYPE

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. CADDY; brand of nVent Electrical plc.
- b. California Dynamics Corporation.
- c. Kinetics Noise Control, Inc.
- d. Mason Industries, Inc.
- e. VMC GROUP.

- B. Seismic-Restraint Cables: ASTM A492 stainless steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for seismic restraining cable service; with fittings attached by means of poured socket, swaged socket or mechanical (Flemish eye) loop.
- C. Restraint cable assembly and cable fittings must comply with ASCE/SEI 19. All cable fittings and complete cable assembly must maintain the minimum cable breaking force. U-shaped cable clips and wedge type end fittings do not comply and are unacceptable.

## 2.16 RESTRAINT ACCESSORIES

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. CADDY; brand of nVent Electrical plc.
- b. California Dynamics Corporation.
- c. Kinetics Noise Control, Inc.
- d. Mason Industries, Inc.
- e. VMC GROUP.

Retain "Hanger-Rod Stiffener" Paragraph below for strengthening resistance of hanger rods against seismic and wind-load forces that may cause buckling of rods; delete if detailed on Drawings. Use with either rigid- or cable-type bracing assemblies when required to counter seismic and wind-load forces. Detail fabrication and indicate locations on Drawings.

- B. Hanger-Rod Stiffener: Reinforcing steel angle clamped to hanger rod. Non-metallic stiffeners are unacceptable.
- C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.
- D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

- E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.
- F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

## 2.17 POST-INSTALLED CONCRETE ANCHORS

### A. Mechanical Anchor Bolts:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Atkore Unistrut.
  - b. Cooper B-line; brand of Eaton, Electrical Sector.
  - c. Hilti, Inc.
  - d. Mason Industries, Inc.
  - e. Powers Fasteners.
- 2. Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488/E488M.

### B. Adhesive Anchor Bolts:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Atkore Unistrut.
  - b. Cooper B-line; brand of Eaton, Electrical Sector.
  - c. Hilti, Inc.
  - d. Mason Industries, Inc.
  - e. Powers Fasteners.
- 2. Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488/E488M.

### C. Provide post-installed concrete anchors that have been prequalified for use in seismic applications. Post-installed concrete anchors must comply with all requirements of ASCE/SEI 7-16, Ch. 13.

- 1. Prequalify post-installed anchors in concrete in accordance with ACI 355.2 or other approved qualification testing procedures.
- 2. Prequalify post-installed anchors in masonry in accordance with approved qualification procedures.

2.18 CONCRETE INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Atkore Unistrut.
  2. Cooper B-line; brand of Eaton, Electrical Sector.
  3. Hilti, Inc.
  4. Mason Industries, Inc.
  5. Powers Fasteners.
- B. Provide preset concrete inserts, which are seismically prequalified in accordance with ICC-ES AC466 testing.
- C. Comply with ANSI/MSS 58.

2.19 VIBRATION ISOLATION EQUIPMENT BASES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. CADDY; brand of nVent Electrical plc.
  2. California Dynamics Corporation.
  3. Kinetics Noise Control, Inc.
  4. Mason Industries, Inc.
  5. NOVIA; a division of Carpenter & Paterson.
  6. VMC GROUP.
  7. Vibration Eliminator Co., Inc.
  8. Vibration Isolation.
  9. Vibration Management Corp.
- B. Steel Rails: Factory-fabricated, welded, structural-steel rails.
1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide rails.

Retain first subparagraph below if steel rails are required for pumps.

- a. Include supports for suction and discharge elbows for pumps.
  2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Rails shall have shape to accommodate supported equipment.
  3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- C. Steel Bases: Factory-fabricated, welded, structural-steel bases and rails.
1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

Retain first subparagraph below if steel bases are required for pumps.

- a. Include supports for suction and discharge elbows for pumps.
2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- D. Concrete Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.
  1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

Retain first subparagraph below if inertia bases are required for pumps.

- a. Include supports for suction and discharge elbows for pumps.
2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

Indicate on Drawings, by details, schedules, or a combination of both, the locations where hanger rods for individual pipes and hanger rods for trapeze hangers require hanger-rod stiffeners.

- B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength is adequate to carry static and seismic load within specified loading limits.

### 3.3 INSTALLATION OF VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICES

- A. Provide vibration-control devices for systems and equipment where indicated in Equipment Schedules or Vibration-Control Device Schedules, where indicated on Drawings, or where the Specifications indicate they are to be installed on specific equipment and systems.
- B. Provide seismic-restraint devices for systems and equipment where indicated in Equipment Schedules or Seismic-Restraint Devices Schedules, where indicated on Drawings, where the Specifications indicate they are to be installed on specific equipment and systems, and where required by applicable codes.
- C. Coordinate location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."
- D. Installation of vibration isolators and seismic restraints must not cause any stresses, misalignment, or change of position of equipment or piping.
- E. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- F. Equipment Restraints:

Indicate type and quantity of snubbers, wind-load-restraint, and seismic-restraint devices described in three subparagraphs below, on Drawings, in Equipment Schedules, or in Plumbing Vibration-Control and Seismic Restraint Device Schedule on Drawings.

- 1. Install snubbers on plumbing equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
  - 2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
  - 3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.
- G. Piping Restraints:
  - 1. Comply with requirements in MSS SP-127.

In first subparagraph below, options for 40 and 80 feet (12 and 24 m) are recommended by MSS SP-127. Revise these dimensions based on the configuration of piping.

- 2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.



3. Brace a change of direction longer than 12 feet.
- H. Install seismic-restraint cables so they do not bend across edges of adjacent equipment or building structure.
- I. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.
- J. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- K. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- L. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- M. Post-Installed Concrete Anchors:
  1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify Project structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
  2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
  3. Mechanical-Type Anchor Bolts: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
  4. Adhesive-Type Anchor Bolts: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
  5. Set anchors to manufacturer's recommended torque, using a torque wrench.
  6. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

### 3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

[Coordinate this article with Drawings.](#)

- A. Provide flexible connections in piping systems where they cross structural seismic joints and other point where differential movement may occur. Provide adequate flexibility to accommodate differential movement as determined in accordance with ASCE/SEI 7. Comply with requirements in Section 221116 "Domestic Water Piping" and Section 221119 "Domestic Water Piping Specialties" for piping flexible connections.

### 3.5 INSTALLATION OF VIBRATION ISOLATION EQUIPMENT BASES

- A. Coordinate location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."
- B. Coordinate dimensions of steel equipment rails, bases, and concrete inertia bases, with requirements of isolated equipment specified in this and other Sections. Where dimensions of bases are indicated on Drawings, they may require adjustment to accommodate actual isolated equipment.

### 3.6 ADJUSTING

- A. Adjust isolators after system is at operating weight.
- B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

### 3.7 FIELD QUALITY CONTROL

Retain first option in "Testing Agency" Paragraph below if Owner will hire an independent testing agency.

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

Retain "Manufacturer's Field Service" Paragraph below to require a factory-authorized service representative 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. Tests and Inspections:

Retain "Perform tests and inspections" Subparagraph below to require Contractor to perform tests and inspections, and retain option to require Contractor to arrange for the assistance of a factory-authorized service agent.

1. Perform tests and inspections with the assistance of a factory-authorized service representative.
2. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
3. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
4. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
5. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
6. Test to 90 percent of rated proof load of device.

7. Measure isolator restraint clearance.
8. Measure isolator deflection.
9. Verify snubber minimum clearances.

Retain subparagraph below if restrained-air-spring isolators are included in Project.

- D. Remove and replace malfunctioning units and retest as specified above.

See Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

- E. Units will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION 220548

## SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Valve tags.
5. Warning tags.

B. Related Requirements:

1. Section 226113 "Compressed-Air Piping for Laboratory and Healthcare Facilities" for labeling requirements, complying with NFPA 99, for medical, compressed-air system piping and associated components in healthcare facilities.
2. Section 226313 "Gas Piping for Laboratory and Healthcare Facilities" for labeling requirements, complying with NFPA 99, for medical carbon dioxide, laboratory carbon dioxide, medical helium, laboratory helium, medical nitrogen, laboratory nitrogen, medical nitrous oxide, laboratory nitrous oxide, medical oxygen, and laboratory oxygen.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment-Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve-numbering scheme.

- E. Valve Schedules: For each piping system. Include in operation and maintenance manuals.

## PART 2 - PRODUCTS

### 2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Brady Corporation.
  - b. Carlton Industries, LP.
  - c. Champion America.
  - d. Craftmark Pipe Markers.
  - e. Kolbi Pipe Marker Co.
  - f. LEM Products Inc.
  - g. Marking Services Inc.
  - h. Pipemarket.com; Brimar Industries, Inc.
  - i. Seton Identification Products; a Brady Corporation company.
  - j. emedco.
2. Material and Thickness: Brass, 0.032-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
3. Letter and Background Color: As indicated for specific application under Part 3.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
6. Fasteners: Stainless steel rivets or self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

## 2.2 WARNING SIGNS AND LABELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Brady Corporation.
  - 2. Carlton Industries, LP.
  - 3. Champion America.
  - 4. Craftmark Pipe Markers.
  - 5. LEM Products Inc.
  - 6. Marking Services Inc.
  - 7. National Marker Company.
  - 8. Pipemarket.com; Brimar Industries, Inc.
  - 9. Seton Identification Products; a Brady Corporation company.
  - 10. Stranco, Inc.
  - 11. emedco.
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Arc-Flash Warning Signs: Provide arc-flash warning signs in locations and with content in accordance with requirements of OSHA and NFPA 70E, and other applicable codes and standards.
- J. Label Content: Include caution and warning information plus emergency notification instructions.

## 2.3 PIPE LABELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Actioncraft Products, Inc.; a division of Industrial Test Equipment Co., Inc.
  2. Brady Corporation.
  3. Carlton Industries, LP.
  4. Champion America.
  5. Craftmark Pipe Markers.
  6. Kolbi Pipe Marker Co.
  7. LEM Products Inc.
  8. Marking Services Inc.
  9. Pipemarker.com; Brimar Industries, Inc.
  10. Seton Identification Products; a Brady Corporation company.
  11. emedco.
- B. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- E. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- F. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include:
1. Pipe size.
  2. Flow-Direction Arrows: Include flow-direction arrows on distribution piping. Arrows may be either integral with label or applied separately.
  3. Lettering Size: At least 1/2 inch for viewing distances of up to 72 inches and proportionately larger lettering for greater viewing distances.

## 2.4 VALVE TAGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Actioncraft Products, Inc.; a division of Industrial Test Equipment Co., Inc.

2. Brady Corporation.
3. Carlton Industries, LP.
4. Champion America.
5. Craftmark Pipe Markers.
6. Kolbi Pipe Marker Co.
7. LEM Products Inc.
8. Marking Services Inc.
9. Pipemarker.com; Brimar Industries, Inc.
10. Seton Identification Products; a Brady Corporation company.
11. emedco.

- B. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
1. Tag Material: Brass, 0.04-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
  2. Fasteners: Brass wire.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
1. Include valve-tag schedule in operation and maintenance data.

## 2.5 WARNING TAGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Brady Corporation.
  2. Champion America.
  3. Craftmark Pipe Markers.
  4. Kolbi Pipe Marker Co.
  5. LEM Products Inc.
  6. Marking Services Inc.
  7. Pipemarker.com; Brimar Industries, Inc.
  8. Seton Identification Products; a Brady Corporation company.
  9. emedco.
- B. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.
1. Size: Approximately 4 by 7 inches.
  2. Fasteners: Brass grommet and wire.
  3. Nomenclature: Large-size primary caption, such as "DANGER," "CAUTION," or "DO NOT OPERATE."
  4. Letter and Background Color: As indicated for specific application under Part 3.



### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

#### 3.2 INSTALLATION, GENERAL REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.
- D. Locate identifying devices so that they are readily visible from the point of normal approach.

#### 3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

- A. Permanently fasten labels on each item of plumbing equipment.
- B. Sign and Label Colors.
  - 1. White letters on an ANSI Z535.1 safety-green background.
- C. Locate equipment labels where accessible and visible.
- D. Arc-Flash Warning Signs: Provide arc-flash warning signs on electrical disconnects and other equipment where arc-flash hazard exists, as indicated on Drawings, and in accordance with requirements of OSHA and NFPA 70E, and other applicable codes and standards.

#### 3.4 INSTALLATION OF PIPE LABELS

- A. Piping Color Coding: Painting of piping is specified in Division 9 Painting Specification.
- B. Install pipe labels showing service and flow direction with permanent adhesive on pipes.

- C. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Within 3 ft. of each valve and control device.
  - 2. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 3. Within 3 ft. of equipment items and other points of origination and termination.
  - 4. Spaced at maximum intervals of 25 ft. along each run. Reduce intervals to 5 ft. in areas of congested piping and equipment.
- D. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of 125 deg F or higher. Where these pipes are to remain uninsulated, use a short section of insulation or use stenciled labels.
- E. Flow-Direction Flow Arrows: Use arrows, in compliance with ASME A13.1, to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- F. Pipe-Label Color Schedule:
  - 1. Low-Pressure Compressed-Air Piping: White letters on an ANSI Z535.1 safety-blue background.
  - 2. Domestic Cold-Water Piping: White letters on an ANSI Z535.1 safety-green background.
  - 3. Domestic Hot-Water Piping: White letters on an ANSI Z535.1 safety-green background
  - 4. Domestic Hot-Water Return Piping White letters on an ANSI Z535.1 safety-green background.
  - 5. Sanitary Waste and Storm Drainage Piping: White letters on a black background.

### 3.5 INSTALLATION OF VALVE TAGS

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule in the operating and maintenance manual.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:

1. Valve-Tag Size and Shape:

- a. Domestic Cold Water: 2 inches, round.
- b. Domestic Hot Water: 2 inches, round.
- c. Domestic Hot-Water Return: 2 inches, round.
- d. Low-Pressure Compressed Air: 2 inches, round.

2. Valve-Tag Colors:

- a. For each piping system, use the same lettering and background coloring system on valve tags as used in the piping system labels and background.

3.6 INSTALLATION OF WARNING TAGS

- A. Warning Tag Color: Black letters on an ANSI Z535.1 safety-yellow background.
- B. Attach warning tags, with proper message, to equipment and other items where required by code and where recommended by equipment or product manufacturer(s).

END OF SECTION 220553

## SECTION 220593 - TESTING, ADJUSTING, AND BALANCING FOR PLUMBING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

- 1. TAB of domestic water system.
- 2. TAB of plumbing equipment:
  - a. Domestic water booster pumps.
  - b. Domestic hot-water in-line circulation pumps.
  - c. General-duty air compressors.
  - d. Sanitary sewage pumps.
- 3. Pipe-leakage test verification.
- 4. Testing, adjusting, and balancing of existing plumbing systems and equipment.

#### 1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.

- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- F. TDH: Total dynamic head.

#### 1.4 PREINSTALLATION MEETINGS

- A. TAB Conference: Conduct a TAB conference at Project site after approval of the TAB strategies and procedures plan, to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.
  - 1. Minimum Agenda Items:
    - a. The Contract Documents examination report.
    - b. The TAB plan.
    - c. Needs for coordination and cooperation of trades and subcontractors.
    - d. Proposed procedures for documentation and communication flow.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 60 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 60 days of Contractor's Notice to Proceed, submit the Contract Documents review report, as specified in Part 3.
- C. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures, as specified in "Preparation" Article.

- D. System Readiness Checklists: Within 60 days of Contractor's Notice to Proceed, submit system readiness checklists, as specified in "Preparation" Article.
- E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.
- F. Certified TAB reports.
- G. Sample report forms.
- H. Instrument calibration reports, to include the following:
  - 1. Instrument type and make.
  - 2. Serial number.
  - 3. Application.
  - 4. Dates of use.
  - 5. Dates of calibration.

#### 1.6 QUALITY ASSURANCE

- A. TAB Specialists Qualifications, Certified by AABC:
  - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
  - 2. TAB Technician: Employee of the TAB specialist and certified by AABC.
- B. TAB Specialists Qualifications, Certified by NEBB or TABB:
  - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB or TABB.
  - 2. TAB Technician: Employee of the TAB specialist and certified by NEBB or TABB.
- C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- D. ASHRAE 111 Compliance: Requirements in ASHRAE 111 applicable to analogous domestic water system and plumbing equipment balancing.

- E. ASHRAE 188 Compliance: Comply with balancing and report requirements, Section 8.3 "Balancing."
- F. Code and Authorities Having Jurisdiction Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

#### 1.7 FIELD CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

#### PART 2 - PRODUCTS (Not Applicable)

#### PART 3 - EXECUTION

##### 3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, and balancing valves and fittings. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine approved submittals for plumbing systems and equipment.
- D. Examine design data, including plumbing system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about plumbing system and equipment controls.
- E. Examine equipment performance data, including pump curves.
  - 1. Relate performance data to Project conditions and requirements, including pump system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

2. Calculate pump system-effect factors to reduce performance ratings of plumbing equipment when installed under conditions different from the conditions used to rate equipment performance. Compare results with the design data and installed conditions.
- F. Examine system and equipment installations, and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- G. Examine test reports specified in individual system and equipment Sections.
- H. Examine plumbing equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- I. Examine temporary and permanent strainers. Verify that temporary strainer screens used during system cleaning and flushing have been removed and permanent strainers are installed and clean.
- J. Examine control valves for proper installation for their intended function of isolating, throttling, diverting, or mixing fluid flows.
- K. Examine system pumps to ensure absence of entrained air in the suction piping.
- L. Examine operating safety interlocks and controls on plumbing equipment.
- M. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

### 3.2 PREPARATION

- A. Prepare a TAB plan that includes the following:
  1. Equipment and systems to be tested.
  2. Strategies and step-by-step procedures for balancing the systems.
  3. Instrumentation to be used.
  4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of plumbing systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
  1. Domestic Water System:
    - a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed in accordance with applicable code and authority having jurisdiction.
    - b. Water heaters are installed and functioning.
    - c. Piping is complete and all points of outlet are installed.
    - d. Water treatment is complete.



- e. Systems are flushed, filled, and air purged.
  - f. Strainers are clean.
  - g. Control valves are functioning in accordance with the sequence of operation.
  - h. Shutoff and balance valves are 100 percent open.
  - i. Booster- and hot-water circulating pumps are operational and proper rotation is verified.
  - j. Pump gauge connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
  - k. Variable-frequency controllers' startup is complete and safeties are verified.
  - l. Suitable access to balancing devices and equipment is provided.
2. Sanitary Sewage/Drainage System:
- a. Leakage and pressure tests on sanitary sewage/drainage systems have been completed in accordance with applicable code and authority having jurisdiction requirements.
  - b. Piping is complete.
  - c. Sanitary sewage pumps/drainage pumps are operational.
  - d. Control valves are functioning in accordance with the sequence of operation.
  - e. Shutoff valves are 100 percent open.
  - f. Suitable access to equipment is provided.
3. Compressed-Air System:
- a. Leakage and pressure tests on compressed air distribution system have been satisfactorily completed in accordance with Division 22 requirements.
  - b. Piping is complete and all points of outlet are installed.
  - c. Systems are flushed, filled, and air purged.
  - d. Strainers are clean.
  - e. Control valves are functioning in accordance with the sequence of operation.
  - f. Shutoff and balance valves are 100 percent open.
  - g. Compressors are operational and of proper rotation.
  - h. Gauge connections are installed directly at compressor inlet and outlet flanges prior to valves or strainers.
  - i. Variable-frequency controllers' startup is complete and safeties are verified.
  - j. Suitable access to balancing devices and equipment is provided,

### 3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system in accordance with the procedures contained in ASHRAE 111 and in this Section.

- B. Cut insulation, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.
  - 1. Where holes for probes are required in piping or equipment, install pressure and temperature test plugs to seal systems.
  - 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with Section 220716 "Plumbing Equipment Insulation" and Section 220719 "Plumbing Piping Insulation."
- C. Mark equipment and balancing devices, including valve position indicators and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

### 3.4 GENERAL PROCEDURES FOR PLUMBING EQUIPMENT

- A. Test, adjust, and balance plumbing equipment indicated on Drawings, including, but not limited to, the following:
  - 1. Motors.
  - 2. Domestic water booster pumps.
  - 3. Domestic water in-line pumps.
  - 4. Domestic water heaters.
  - 5. Sanitary sewage pumps.
  - 6. Drainage pumps.
  - 7. Air compressors.

### 3.5 PROCEDURES FOR DOMESTIC WATER SYSTEMS

- A. Prepare test reports for pumps and other equipment. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required equipment flow rates with system design flow rates.
- B. Prepare schematic diagrams of systems' Record drawings piping layouts.
- C. In addition to requirements in "Preparation" Article, prepare domestic water systems for testing and balancing as follows:
  - 1. Check expansion tank for proper setting.
  - 2. Check water heater for proper discharge temperature setting.
  - 3. Check remotest point of outlet for adequate pressure.
  - 4. Check flow-control valves for proper position.
  - 5. Locate start-stop and disconnect switches, electrical interlocks, and motor controllers.
  - 6. Verify that motor controllers are equipped with properly sized thermal protection.
  - 7. Check that air has been purged from the system.

- D. Measure and record upstream and downstream pressure of each piece of equipment.
- E. Measure and record upstream and downstream pressure of pressure-reducing valves.
- F. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.
- G. Check settings and operation of each safety valve. Record settings.

### 3.6 PROCEDURES FOR COMPRESSED-AIR SYSTEMS

- A. Prepare test reports for air compressors, and other equipment. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required equipment flow rates with system design flow rates.
- B. Prepare schematic diagrams of systems' Record drawings piping layouts.
- C. In addition to requirements in "Preparation" Article, prepare compressed-air systems for testing and balancing as follows:
  - 1. Check remotest point of outlet for adequate pressure.
  - 2. Check pressure-control valves for proper position.
  - 3. Locate start-stop and disconnect switches, electrical interlocks, and motor controllers.
  - 4. Verify that motor controllers are equipped with properly sized thermal protection.
- D. Measure and record upstream and downstream pressure of pressure-reducing valves.
- E. Check settings and operation of pressure-reducing valves. Record final settings.
- F. Check settings and operation of each safety valve. Record settings.

### 3.7 PROCEDURES FOR DOMESTIC WATER SYSTEM BOOSTER PUMPS

- A. Adjust pumps to deliver total design flow.
  - 1. Measure total water flow.
    - a. Position valves for full flow through coils.
    - b. Measure flow by main flow meter, if installed.
    - c. If main flow meter is not installed, determine flow by pump TDH or known equipment pressure drop.
  - 2. Measure pump TDH as follows:

- a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
    - b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
    - c. Convert pressure to head and correct for differences in gauge heights.
    - d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
    - e. With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved. If excessive throttling is required to achieve desired flow, recommend pump impellers be trimmed to reduce excess throttling.
  3. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.
- B. Adjust flow-measuring devices installed in mains and branches to design water flows.
1. Measure flow in main and branch pipes.
  2. Adjust main and branch balance valves for design flow.
  3. Re-measure each main and branch after all have been adjusted.

C. Verify final system conditions as follows:

1. Re-measure and confirm that total water flow is within design.
2. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
3. Mark final settings.

D. Verify that memory stops have been set.

3.8 PROCEDURES FOR DOMESTIC HOT-WATER CIRCULATING INLINE PUMP

A. Balance system with manual or automatic balancing valves by setting at design flow.

1. Measure flow in main and branch pipes.
2. Adjust main and branch balance valves for design flow.
3. Re-measure each main and branch after all have been adjusted.

B. Adjust pump to deliver total design flow.

1. Measure pump TDH as follows:
  - a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
  - b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
  - c. Convert pressure to head and correct for differences in gauge heights.
  - d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
2. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.
3. Mark final settings and verify that all memory stops have been set.
4. Verify final system conditions as follows:
  - a. Re-measure and confirm that total flow is within design.
  - b. Re-measure final pumps' operating data, TDH, volts, amps, speed, and static profile.
  - c. Mark final settings.

3.9 PROCEDURES FOR MOTORS

A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Phase and hertz.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter size and thermal-protection-element rating.
8. Service factor and frame size.

- B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

### 3.10 PROCEDURES FOR WATER HEATERS

- A. Electric Water Heaters:

1. Measure and record entering- and leaving-water temperatures.
2. Measure and record water flow.
3. Measure and record pressure drop.
4. Measure and Record relief valve(s) pressure setting.
5. Capacity: Calculate in Btu/h of heating output.
6. Efficiency: Calculate operating efficiency for comparison to submitted equipment.

- B. Gas- and Oil-Fired Water Heaters:

1. Measure and record entering- and leaving-water temperatures.
2. Measure and record water flow.
3. Measure and record pressure drop.
4. Measure and Record relief valve(s) pressure setting.
5. Capacity: Calculate in Btu/h of heating output.
6. Fuel Consumption: If fuel supply is equipped with flow meter, measure and record consumption.
7. Efficiency: Calculate operating efficiency for comparison to submitted equipment.
8. Fan, motor, and motor controller operating data.

### 3.11 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

1. Measure and record flows, temperatures, and pressures of each piece of equipment. Compare the values to design or nameplate information, where information is available.
2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
3. Check the condition of filters.

4. Check bearings and other lubricated parts for proper lubrication.
  5. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
- B. TAB After Construction: Before performing testing and balancing of renovated existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished in accordance with renovation scope indicated by Contract Documents. Verify the following:
1. New filters are installed.
  2. Bearings and other parts are properly lubricated.
  3. Deficiencies noted in the preconstruction report are corrected.
- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
1. Compare the indicated system flows of the renovated work to the measured flows, and determine the new pump speed.
  2. Verify that the indicated system flows of the renovated work result in velocities and pump speeds that are within the acceptable limits defined by equipment manufacturer.
  3. If calculations increase or decrease the system flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.

### 3.12 TOLERANCES

- A. Set plumbing system's flow rates within the following tolerances:
1. Domestic Water Flow Rate: Plus 10 percent or minus 5 percent. If design value is less than 10 gpm, within 10 percent.
  2. Compressed-Air Flow Rate: Plus 10 percent or minus 5 percent. If design value is less than 10 cfm, within 10 percent.

### 3.13 PROGRESS REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for system-balancing devices. Recommend changes and additions to system-balancing devices, to facilitate proper performance measuring and balancing. Recommend changes and additions to plumbing systems and general construction to allow access for performance-measuring and -balancing devices.
- B. Status Reports: Prepare monthly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.14 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
  - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
  - 2. Include a list of instruments used for procedures, along with proof of calibration.
  - 3. Certify validity and accuracy of field data.



- B. Final Report Contents: In addition to certified field-report data, include the following:
1. Pump curves.
  2. Manufacturers' test data.
  3. Field test reports prepared by system and equipment installers.
  4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.
- C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.
  2. Name and address of the TAB specialist.
  3. Project name.
  4. Project location.
  5. Architect's name and address.
  6. Engineer's name and address.
  7. Contractor's name and address.
  8. Report date.
  9. Signature of TAB supervisor who certifies the report.
  10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
  11. Summary of contents, including the following:
    - a. Indicated versus final performance.
    - b. Notable characteristics of systems.
    - c. Description of system operation sequence if it varies from the Contract Documents.
  12. Nomenclature sheets for each item of equipment.
  13. Notes to explain why certain final data in the body of reports vary from indicated values.
  14. Test conditions for pump performance forms, including the following:
    - a. Variable-frequency controller settings for variable-flow hydronic systems.
    - b. Settings for pressure controller(s).
    - c. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of distribution systems. Present each system with single-line diagram and include the following:
1. Flow rates.
  2. Pipe and valve sizes and locations.
  3. Balancing stations.
  4. Position of balancing devices.
- E. Gas- and Oil-Fired Water Heaters Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
1. Unit Data:
    - a. System identification.

- b. Location.
    - c. Make and type.
    - d. Model number and unit size.
    - e. Manufacturer's serial number.
    - f. Fuel type in input data.
    - g. Output capacity in Btu/h.
    - h. Ignition type.
    - i. Burner-control types.
    - j. Motor horsepower and speed.
    - k. Motor volts, phase, and hertz.
    - l. Motor full-load amperage and service factor.
    - m. Sheave make, size in inches, and bore.
    - n. Center-to-center dimensions of sheave and amount of adjustments in inches.
  - 2. Test Data (Indicated and Actual Values):
    - a. Total airflow rate in cfm.
    - b. Entering-water temperature in deg F.
    - c. Leaving-water temperature in deg F.
    - d. Low-fire fuel input in Btu/h.
    - e. High-fire fuel input in Btu/h.
    - f. High-temperature-limit setting in deg F.
    - g. Operating set point in Btu/h.
    - h. Heating value of fuel in Btu/h.
- F. Electric Water Heater Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
- 1. Unit Data:
    - a. System identification.
    - b. Location.
    - c. Model number and unit size.
    - d. Manufacturer's serial number.
    - e. Output capacity in Btu/h.
    - f. Number of stages.
    - g. Connected volts, phase, and hertz.
    - h. Rated amperage.
  - 2. Test Data (Indicated and Actual Values):
    - a. Heat output in Btu/h.
    - b. Entering-water temperature in deg F.
    - c. Leaving-water temperature in deg F.
    - d. High-temperature-limit setting in deg F.
    - e. Operating set point in deg F.
    - f. Voltage at each connection.
    - g. Amperage for each phase.

G. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves, and include the following:

1. Unit Data:
  - a. Unit identification.
  - b. Location.
  - c. Service.
  - d. Make and size.
  - e. Model number and serial number.
  - f. Water flow rate in gpm.
  - g. Water-pressure differential in feet of head or psig.
  - h. Required net positive suction head in feet of head or psig.
  - i. Pump speed.
  - j. Impeller diameter in inches.
  - k. Motor make and frame size.
  - l. Motor horsepower and rpm.
  - m. Voltage at each connection.
  - n. Amperage for each phase.
  - o. Full-load amperage and service factor.
  - p. Seal type.
2. Test Data (Indicated and Actual Values):
  - a. Static head in feet of head or psig.
  - b. Pump shutoff pressure in feet of head or psig.
  - c. Actual impeller size in inches.
  - d. Full-open flow rate in gpm.
  - e. Full-open pressure in feet of head or psig.
  - f. Final discharge pressure in feet of head or psig.
  - g. Final suction pressure in feet of head or psig.
  - h. Final total pressure in feet of head or psig.
  - i. Final water flow rate in gpm.
  - j. Voltage at each connection.
  - k. Amperage for each phase.

H. Instrument Calibration Reports:

1. Report Data:
  - a. Instrument type and make.
  - b. Serial number.
  - c. Application.
  - d. Dates of use.
  - e. Dates of calibration.

### 3.15 VERIFICATION OF TAB REPORT

- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Commissioning Authority.
- B. Commissioning Authority shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to the lesser of either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
- C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the TAB shall be considered incomplete and shall be rejected.
- E. If recheck measurements find the number of failed measurements noncompliant with requirements indicated, proceed as follows:
  - 1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection. All changes shall be tracked to show changes made to previous report.
  - 2. If the second final inspection also fails, Owner may pursue other Contract options to complete TAB work.
- F. Prepare test and inspection reports.

### 3.16 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

END OF SECTION 220593

## SECTION 220719 - PLUMBING PIPING INSULATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section includes insulating the following plumbing piping services:

1. Domestic cold-water piping.
2. Domestic hot-water piping.
3. Domestic recirculating hot-water piping.
4. Roof drains and rainwater leaders.
5. Supplies and drains for handicap-accessible lavatories and sinks.

B. Related Sections:

1. Section 220716 "Plumbing Equipment Insulation" for equipment insulation.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.

3. Detail insulation application at pipe expansion joints for each type of insulation.
  4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  5. Detail removable insulation at piping specialties, equipment connections, and access panels.
  6. Detail application of field-applied jackets.
  7. Detail application at linkages of control devices.
- C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:
1. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
  2. Jacket Materials for Pipe: 12 inches long by NPS 2.
  3. Sheet Jacket Materials: 12 inches square.
  4. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

### 1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

- B. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.

1. Piping Mockups:

- a. One 10-foot section of NPS 2 straight pipe.
  - b. One each of a 90-degree threaded, welded, and flanged elbow.
  - c. One each of a threaded, welded, and flanged tee fitting.
  - d. One NPS 2 or smaller valve and one NPS 2-1/2 or larger valve.
  - e. Four support hangers, including hanger shield and insert.
  - f. One threaded strainer and one flanged strainer with removable portion of insulation.
  - g. One threaded reducer and one welded reducer.
  - h. One pressure temperature tap.
  - i. One mechanical coupling.
  - j. One union.
2. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
  3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
  4. Obtain Architect's approval of mockups before starting insulation application.
  5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
  7. Demolish and remove mockups when directed.

- C. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation system materials are to be delivered to the Project site in unopened containers. The packaging is to include name of the manufacturer, fabricator, type, description, and size, as well as ASTM standard designation and maximum use temperature.

#### 1.6 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

#### 1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.
  - 1. All Insulation Installed Indoors and Outdoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.



## 2.2 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials are applied.
- B. Products do not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come into contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.
- E. Glass-Fiber, Preformed Pipe: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 850 deg F in accordance with ASTM C411. Comply with ASTM C547.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Johns Manville; a Berkshire Hathaway company.
    - b. Knauf Insulation.
    - c. Manson Insulation Inc.
    - d. Owens Corning.
  - 2. Preformed Pipe Insulation: Type I, Grade A with factory-applied ASJ-SSL.
  - 3. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
  - 4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

## 2.3 INSULATING CEMENTS

- A. Glass-Fiber and Mineral Wool Insulating Cement: Comply with ASTM C195.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Ramco Insulation, Inc.
- B. Glass-Fiber and Mineral Wool Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Ramco Insulation, Inc.

## 2.4 ADHESIVES

- A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Glass-Fiber and Mineral Wool Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Childers Brand; H. B. Fuller Construction Products.
- b. Foster Brand; H. B. Fuller.
- c. Mon-Eco Industries, Inc.

2.5 MASTICS AND COATINGS

- A. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Foster Brand; H. B. Fuller.
    - c. Knauf Insulation.
    - d. Mon-Eco Industries, Inc.
    - e. Vimasco Corporation.
  2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
  3. Service Temperature Range: 0 to plus 180 deg F.
  4. Comply with MIL-PRF-19565C, Type II, for permeance requirements, with supplier listing on DOD QPD - Qualified Products Database.
  5. Color: White.
- B. Vapor-Retarder Mastic, Solvent Based, Indoor Use: Suitable for indoor use on below-ambient services.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Foster Brand; H. B. Fuller.
    - c. Mon-Eco Industries, Inc.
  2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
  3. Service Temperature Range: 0 to 180 deg F.
  4. Color: White.
- C. Vapor-Retarder Mastic, Solvent Based, Outdoor Use: Suitable for outdoor use on below-ambient services.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Foster Brand; H. B. Fuller.
  2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
  3. Service Temperature Range: Minus 50 to plus 220 deg F.
  4. Color: White.
- D. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.

- b. Foster Brand; H. B. Fuller.
  - c. Knauf Insulation.
  - d. Mon-Eco Industries, Inc.
  - e. Vimasco Corporation.
- 2. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm at manufacturer's recommended dry film thickness.
  - 3. Service Temperature Range: 0 to plus 180 deg F.
  - 4. Color: White.

## 2.6 SEALANTS

- A. Materials are as recommended by the insulation manufacturer and are compatible with insulation materials, jackets, and substrates.
- B. Joint Sealants:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Foster Brand; H. B. Fuller.
    - c. Mon-Eco Industries, Inc.
    - d. Owens Corning.
  - 2. Permanently flexible, elastomeric sealant.
  - 3. Service Temperature Range: Minus 58 to plus 176 deg F.
  - 4. Color: White or gray.

C. FSK and Metal Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Childers Brand; H. B. Fuller Construction Products.
  - b. Foster Brand; H. B. Fuller.
  - c. Mon-Eco Industries, Inc.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: Aluminum.

D. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Childers Brand; H. B. Fuller Construction Products.
  - b. Foster Brand; H. B. Fuller.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.

2.7 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
  2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
  3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
  4. ASJ+: Aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film leaving no paper exposed; complying with ASTM C1136 Types I, II, III, IV, and VII.

5. PSK Jacket: Aluminum foil fiberglass reinforced scrim with polyethylene backing, complying with ASTM C1136, Type II.

## 2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets comply with ASTM C1136, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Airex Manufacturing Inc.
    - b. Johns Manville; a Berkshire Hathaway company.
    - c. P.I.C. Plastics, Inc.
    - d. Proto Corporation.
    - e. Speedline Corporation.
  2. Adhesive: As recommended by jacket material manufacturer.
  3. Color: White.
  4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
    - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
- D. Metal Jacket:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Johns Manville; a Berkshire Hathaway company.
    - b. RPR Products, Inc.
  2. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
    - a. Sheet and roll stock ready for shop or field sizing or Factory cut and rolled to size.
    - b. Finish and thickness are indicated in field-applied jacket schedules.
    - c. Moisture Barrier for Indoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
    - d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
    - e. Factory-Fabricated Fitting Covers:
      - 1) Same material, finish, and thickness as jacket.

- 2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
  - 3) Tee covers.
  - 4) Flange and union covers.
  - 5) End caps.
  - 6) Beveled collars.
  - 7) Valve covers.
  - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
- E. Self-Adhesive Outdoor Jacket (Asphaltic): 60-mil-thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross-laminated polyethylene film covered with stucco-embossed aluminum-foil facing.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. MFM Building Products Corp.
    - b. Polyguard Products, Inc.
- F. Self-Adhesive Indoor/Outdoor Jacket (Non-Asphaltic): Vapor barrier and waterproofing jacket for installation over insulation located aboveground outdoors or indoors. Specialized jacket with five layers of laminated aluminum and polyester film with low-temperature acrylic pressure-sensitive adhesive. Outer aluminum surface is coated with UV-resistant coating for protection from environmental contaminants.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. 3M.
    - b. Foster Brand; H. B. Fuller.
    - c. Ideal Tape Co., Inc., an American Biltrite Company.
  2. Permeance: 0.00 perm as tested in accordance with ASTM F1249.
  3. Flamespread/Smoke Developed: 25/50 as tested in accordance with ASTM E84.
  4. Aluminum Finish: Embossed.

## 2.9 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. 3M Industrial Adhesives and Tapes Division.
    - b. Avery Dennison Corporation, Specialty Tapes Division.
    - c. Ideal Tape Co., Inc., an American Biltrite Company.
    - d. Knauf Insulation.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. 3M Industrial Adhesives and Tapes Division.
  - b. Ideal Tape Co., Inc., an American Biltrite Company.
2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. 3M Industrial Adhesives and Tapes Division.
  - b. Avery Dennison Corporation, Specialty Tapes Division.
  - c. Ideal Tape Co., Inc., an American Biltrite Company.
  - d. Knauf Insulation.
2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

## 2.10 SECUREMENTS

A. Bands:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Johns Manville; a Berkshire Hathaway company.
  - b. RPR Products, Inc.
2. Stainless Steel: ASTM A240/A240M, Type 304; 0.015 inch thick, 1/2 inch wide with wing seal.



3. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
- C. Wire: 0.062-inch soft-annealed, stainless steel.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. C & F Wire Products.
    - b. Johns Manville; a Berkshire Hathaway company.
    - c. RPR Products, Inc.

## 2.11 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Buckaroos, Inc.
    - b. MVG Molded Products.
    - c. McGuire Manufacturing.
    - d. Plumberex Specialty Products, Inc.
    - e. ProFlo; a Ferguson Enterprises, Inc. brand.
    - f. Truebro; IPS Corporation.
    - g. Zurn Industries, LLC.
  2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
  1. Verify that systems to be insulated have been tested and are free of defects.
  2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

- B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
  - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range of between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
  - 2. Carbon Steel: Coat carbon steel operating at a service temperature of between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

### 3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.
- D. Install insulation with longitudinal seams at top and bottom (12 o'clock and 6 o'clock positions) of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with Contract Documents, unless otherwise approved by the engineer-of-record.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
  - 3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
  - 2. Cover circumferential joints with 3-inch-wide strips of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 4 inches o.c.
    - a. For below-ambient services, apply vapor-barrier mastic over staples.
  - 4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
  - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.
- P. For above-ambient services, do not install insulation to the following:
  - 1. Vibration-control devices.
  - 2. Testing agency labels and stamps.
  - 3. Nameplates and data plates.
  - 4. Cleanouts.

### 3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  - 4. Seal jacket to roof flashing with flashing sealant.

- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  - 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
  - 1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
  - 1. Pipe: Install insulation continuously through floor penetrations.
  - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

### 3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles below.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:
  - 1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
  - 2. Insulate pipe elbows using preformed fitting insulation made from same material and density as that of adjacent pipe insulation. Each piece is butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.

3. Insulate tee fittings with preformed fitting insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
  4. Insulate valves using preformed fitting insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
  5. Insulate strainers using preformed fitting insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers, so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
  6. Insulate flanges, mechanical couplings, and unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
  7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation conforms to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.
  2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
  3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
  4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe

- insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### 3.6 INSTALLATION OF GLASS-FIBER AND MINERAL WOOL INSULATION

#### A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

#### B. Insulation Installation on Pipe Flanges:

1. Install prefabricated pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with glass-fiber or mineral-wool blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

#### C. Insulation Installation on Pipe Fittings and Elbows:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When prefabricated insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

#### D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When prefabricated sections are not available, install fabricated sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

### 3.7 INSTALLATION OF FIELD-APPLIED JACKETS

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
  - 1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
  - 2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
  - 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
  - 1. Draw jacket material smooth and tight.
  - 2. Install lap or joint strips with same material as jacket.
  - 3. Secure jacket to insulation with manufacturer's recommended adhesive.
  - 4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
  - 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
  - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches o.c. and at end joints.

### 3.8 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
  - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.



- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless steel jackets.

### 3.9 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections.
- B. Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections with the assistance of a factory-authorized service representative.
- E. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection is limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- F. All insulation applications will be considered defective if they do not pass tests and inspections.
- G. Prepare test and inspection reports.

3.10 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
  - 1. Drainage piping located in crawl spaces.
  - 2. Underground piping.
  - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
  - 1. All sizes: Insulation shall be the following:
    - a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- B. Domestic Hot and Recirculated Hot Water:

1. NPS 1-1/4 and Smaller: Insulation is the following:
    - a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
  2. NPS 1-1/2 and Larger: Insulation is the following:
    - a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch thick.
- C. Stormwater and Overflow:
1. All Pipe Sizes: Insulation is the following:
    - a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- D. Roof Drain and Overflow Drain Bodies:
1. All Pipe Sizes: Insulation is the following:
    - a. Glass-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
- 3.12 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE
- A. Domestic Water Piping:

1. All Pipe Sizes: Insulation is the following:
  - a. Glass-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

3.13 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
  1. None.
- D. Piping, Exposed:
  1. Aluminum, Stucco Embossed: 0.024 inch thick.

3.14 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
  - 1. Aluminum, Stucco Embossed with Z-Shaped Locking Seam: 0.040 inch thick.
- D. Piping, Exposed:
  - 1. Aluminum, Stucco Embossed with Z-Shaped Locking Seam: 0.040 inch thick.

3.15 UNDERGROUND, FIELD-APPLIED INSULATION JACKET

- A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 220719

## SECTION 220800 - COMMISSIONING OF PLUMBING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes Cx process requirements for the following plumbing systems, assemblies, and equipment:
  - 1. Domestic hot- and cold-water piping.
  - 2. Sanitary waste and vent piping.
  - 3. Storm drainage piping.
  - 4. Plumbing pumps.
  - 5. General-service compressed-air piping and equipment.
  - 6. Plumbing equipment.
- B. Related Requirements:
  - 1. Section 019113 "General Commissioning Requirements" for general Cx process requirements and CxA responsibilities.
  - 2. For construction checklists, comply with requirements in various Division 22 Sections specifying plumbing systems, system components, equipment, and products.

#### 1.2 DEFINITIONS

- A. Cx: Commissioning, as defined in Section 019113 "General Commissioning Requirements."

- B. CxA: Commissioning Authority, as defined in Section 019113 "General Commissioning Requirements."
- C. IAPMO: International Association of Plumbing and Mechanical Officials.
- D. IgCC: International Green Construction Code.
- E. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, subsystems, equipment, and components.

### 1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For plumbing testing technician.
- B. Construction Checklists:
  - 1. Draft Cx plan, including draft construction checklists to be prepared by CxA under Section 019113 "General Commissioning Requirements." Contractor is to review Construction Checklist in accordance with requirements in Section 019113 "General Commissioning Requirements" and ASHRAE 202 and to resolve any issues with the CxA.
  - 2. Cx plan, including material, installation, and performance construction checklists for systems, assemblies, subsystems, equipment, and components relating to plumbing to be part of the Cx process and in accordance with requirements in Section 019113 "General Commissioning Requirements" and ASHRAE 202.
- C. Test Equipment and Instruments: For all test equipment and instruments to be used in conducting Cx tests by Contractor, provide the following:
  - 1. Equipment/instrument identification number.
  - 2. Planned Cx application or use.
  - 3. Manufacturer, make, model, and serial number.

4. Calibration history, including certificates from agencies that calibrate the equipment and instrumentation.
5. Equipment manufacturers' proprietary instrumentation and tools. For each instrument or tool, identify the following:
  - a. Instrument or tool identification number.
  - b. Equipment schedule designation of equipment for which the instrument or tool is required.
  - c. Manufacturer, make, model, and serial number.
  - d. Calibration history, including certificates from agencies that calibrate the instrument or tool, where appropriate.

#### 1.4 QUALITY ASSURANCE

- A. Plumbing Testing Technician Qualifications: Technicians to perform plumbing Construction Checklist verification tests. Construction Checklist verification test demonstrations, Cx tests, and Cx test demonstrations shall have the following minimum qualifications:
  1. Journey level or equivalent skill level with knowledge of plumbing system, electrical concepts, and building operations.
  2. Minimum three years' experience installing, servicing, and operating systems manufactured by approved manufacturer.
- B. Testing Equipment and Instrumentation Quality and Calibration:
  1. Capable of testing and measuring performance within the specified acceptance criteria.
  2. Be calibrated at manufacturer's recommended intervals with current calibration tags permanently affixed to the instrument being used.
  3. Be maintained in good repair and operating condition throughout duration of use on Project.
  4. Be recalibrated/repared if dropped or damaged in any way since last calibrated.
- C. Proprietary Test Instrumentation and Tools:
  1. Equipment Manufacturer's Proprietary Instrumentation and Tools: For installed equipment included in the Cx process, test instrumentation and tools manufactured or prescribed by equipment manufacturer to service, calibrate, adjust, repair, or otherwise work on its equipment or required as a condition of equipment warranty, shall comply with the following:
    - a. Be calibrated by manufacturer with current calibration tags permanently affixed.
    - b. Include a separate list of proprietary test instrumentation and tools in operation and maintenance manuals.
    - c. Plumbing system proprietary test instrumentation and tools become property of Owner at the time of Substantial Completion.



PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 Cx PROCESS

- A. Perform Cx process for plumbing systems in accordance with:
  - 1. IgCC, which requires compliance with ASHRAE 202.

3.2 CONSTRUCTION CHECKLISTS

- A. Preliminary detailed construction checklists are to be prepared under Section 019113 "General Commissioning Requirements" for each plumbing system, assembly, subsystem, equipment, and component required to be commissioned, as detailed in IgCC. Contractor performs the following:
  - 1. Review plumbing preliminary construction checklists and provide written comments on Construction Checklist items where appropriate.
  - 2. Return preliminary Construction Checklist with review comments within 10 days of receipt.
  - 3. When review comments have been resolved, the CxA will provide final construction checklists marked "Approved for Use, (date)."
  - 4. Use only construction checklists marked "Approved for Use, (date)." Mark construction checklists in the appropriate place, as indicated Project events are completed, and provide pertinent details and other information.
- B. Prepare preliminary detailed construction checklists for each plumbing system, assembly, subsystem, equipment, and component required to be commissioned, as detailed in IgCC.
  - 1. Submit preliminary construction checklists to CxA and Designer for review.
  - 2. When review comments have been resolved, the CxA will provide final construction checklists marked "Approved for Use, (date)."
  - 3. Use only construction checklists marked "Approved for Use, (date)." Mark construction checklists in the appropriate place as indicated Project events are completed, and provide pertinent details and other information.

C. Systems Required to Be Commissioned under IgCC:

1. Domestic hot-water systems and controls.
2. Water-pumping and -mixing systems over 5 hp and purification systems.
3. Renewable energy systems and energy storage systems.

D. Additional Systems Required to Be Commissioned:

1. Domestic water piping, including the following:
  - a. Domestic cold- and hot-water piping, fittings, and specialties inside the building.
  - b. Pumps, motors, accessories, and controls.
  - c. Sleeves and sleeve seals.
  - d. Indoor water-storage tanks.
  - e. Meters and gauges.
  - f. General-duty and specialty valves.
  - g. Hangers and supports.
  - h. Heat tracing.
  - i. Vibration isolation.
2. Sanitary waste and vent piping, including the following:
  - a. Gravity and forced-main sewerage piping, fittings, and specialties.
  - b. Sanitary waste interceptors.
  - c. Pumps, motors, accessories, and controls.
  - d. Drains.
  - e. Sleeves and sleeve seals.
  - f. Meters and gauges.
  - g. General-duty and specialty valves.
  - h. Hangers and supports.
  - i. Heat tracing.
  - j. Vibration isolation.
3. Storm-water piping, including the following:
  - a. Drainage piping, fittings, and specialties.
  - b. Pumps, motors, accessories, and controls.
  - c. Drains and collection basins.
  - d. Rainwater-collection and storage equipment.
  - e. Sleeves and sleeve seals.
  - f. Meters and gauges.
  - g. General-duty and specialty valves.
  - h. Hangers and supports.
  - i. Heat tracing.
  - j. Vibration isolation.
4. Plumbing fixtures, including the following:

- a. Water closets, supports and connections, supplies, and flush valves.
  - b. Urinals, supports and connections, supplies, and flush valves.
  - c. Lavatories, supports, supplies, drain connections, and faucets.
  - d. Sinks, supports, supplies, drain connections, and faucets.
  - e. Tubs, drain connections, and faucets.
  - f. Showers, supplies, drain connections, and faucets.
  - g. Wash fountains, supplies, drain connections, and faucets.
  - h. Emergency plumbing fixtures, supplies, drain connections, and controls.
  - i. Drinking fountains, supplies, and drainage connections.
5. General-service compressed-air piping, including the following:
  - a. Piping, fittings, and specialties inside the building.
  - b. Compressors, motors, accessories, and controls.
  - c. Compressed-air outlets and connections.
  - d. Sleeves and sleeve seals.
  - e. Meters and gauges.
  - f. General-duty and specialty valves.
  - g. Hangers and supports.
  - h. Vibration isolation.

### 3.3 Cx TESTING PREPARATION

- A. Certify that plumbing systems, subsystems, and equipment have been installed, calibrated, and started and that they are operating in accordance with the Contract Documents and approved submittals.
- B. Certify that plumbing system instrumentation and control systems have been completed and calibrated, point-to-point checkout has been successfully completed, and systems are operating in accordance with their design sequence of operation, Contract Documents, and approved submittals. Certify that all sensors are operating within specified accuracy and that all systems are set to and maintaining set points as required by the design documents.
- C. Set systems, subsystems, and equipment into operating mode to be tested in accordance with approved test procedures (for example, normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

### 3.4 Cx TEST CONDITIONS

- A. Perform tests using design conditions, whenever possible.
  1. Simulated conditions may, with approval of Architect, be imposed using an artificial load when it is impractical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by CxA, and document simulated conditions and methods of simulation. After tests, return configurations and settings to normal operating conditions.
  2. Cx test procedures may direct that set points be altered when simulating conditions is impractical.

3. Cx test procedures may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are impractical.
- B. If tests cannot be completed because of a deficiency outside the scope of the plumbing system, document the deficiency and report it to Architect. After deficiencies are resolved, reschedule tests.
- C. If seasonal testing is specified, complete appropriate initial performance tests and documentation and schedule seasonal tests.

### 3.5 Cx TESTS COMMON TO PLUMBING SYSTEMS

- A. Measure capacities and effectiveness of systems, assemblies, subsystems, equipment, and components, including operational and control functions, to verify compliance with acceptance criteria.
- B. Test systems, assemblies, subsystems, equipment, and components for operating modes, interlocks, control responses, responses to abnormal or emergency conditions, and response compared to acceptance criteria.
- C. Coordinate schedule with, and perform Cx activities at the direction of, CxA.
- D. Comply with Construction Checklist requirements, including material verification, installation checks, startup, and performance test requirements specified in Division 22 Sections specifying plumbing systems and equipment.
- E. Provide technicians, instrumentation, tools, and equipment to perform and document the following:
  1. Cx Construction Checklist verification tests.
  2. Cx Construction Checklist verification test demonstrations.

### 3.6 CONSTRUCTION CHECKLIST EXAMPLES

- A. Vibration Isolation in Plumbing Systems:
  1. Prerequisites: Acceptance of results of construction checklists for vibration control devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."
  2. Components to Be Tested:
    - a. Vibration isolation control devices in plumbing systems.
    - b. Support systems.
  3. Test Purpose: Evaluate effectiveness of vibration isolation control devices.

4. Test Conditions: Measure vibration of the facility structure at three locations designated by Owner's witness at the following operating conditions:
    - a. Maximum speed.
    - b. Minimum speed.
    - c. Critical speed.
  5. Acceptance Criteria: Structure-borne vibration not to exceed specified performance.
- B. Supervision of Alarms in Plumbing Systems:
1. Prerequisites: Acceptance of results of construction checklists for plumbing systems specified in the following Sections:
    - a. Section 221429 "Sump Pumps."
    - b. Section 223400 "Fuel-Fired, Domestic-Water Heaters."
    - c. Section 226113 "Compressed-Air Piping for Laboratory and Healthcare Facilities."
    - d. Section 226313 "Gas Piping for Laboratory and Healthcare Facilities."
    - e. Section 331415 "Site Water Distribution Piping."
  2. Test Scope:
    - a. Monitored plumbing system alarms.
  3. Test Purpose:
    - a. Verify reporting of supervised plumbing alarm at building management system.
  4. Test Conditions:
    - a. Alarm monitoring systems operating in normal, automatic mode.
    - b. Activate supervised plumbing alarms, one at a time.
  5. Acceptance Criteria:
    - a. Activation of supervised plumbing alarm generates alarm at building management system control panel.
- C. Plumbing Meter Reporting:

1. Prerequisites: Acceptance of results of construction checklists for plumbing systems specified in the following Sections :
    - a. Section 221119 "Domestic Water Piping Specialties."
    - b. Section 223100 "Domestic Water Softeners."
    - c. Section 331415 "Site Water Distribution Piping."
  2. Test Scope:
    - a. Supervised plumbing system water meters.
  3. Test Purpose:
    - a. Verify accuracy of reporting of supervised plumbing system water meters at building management system.
  4. Test Conditions:
    - a. Plumbing system water meter recording systems operating in normal, automatic mode.
    - b. Compare cumulative consumption data at plumbing system water meter recording systems with independent, calibrated, flow-measuring instrumentation under the following conditions:
      - 1) Low Flow: 1 percent of maximum design flow rate for a period of four hours.
      - 2) High Flow: 80 percent of maximum design flow rate for a period of 20 minutes.
    - c. Activate supervised plumbing alarms, one at a time.
  5. Acceptance Criteria:
    - a. Cumulative flow reported for low-flow condition is within 5 percent flow recorded by calibrated flow-measuring instrumentation.
    - b. Cumulative flow reported for high-flow condition is within 1 percent flow recorded by calibrated flow-measuring instrumentation.
- D. Heat Tracing in Plumbing Systems:
1. Prerequisites: Acceptance of results of construction checklists for heat tracing specified in heat-tracing systems. Comply with requirements listed in Section 220533 "Heat Tracing for Plumbing Piping."
  2. Equipment and Systems To Be Tested:
    - a. Self-regulating, parallel-resistance heating cables.
    - b. Heater trace circuit controller.

3. Test Purpose:
  - a. Evaluate response to ambient temperature below freeze-protection set point.
  - b. Evaluate heating cable fault alarm.
4. Test Conditions:
  - a. Subject temperature sensor to temperature approximately 3 deg F above freeze-protection set point (initial set point 41 deg F). Monitor sensed temperature with a calibration-grade thermometer. Gradually change set point or sensed temperature until freeze-protection circuit is energized.
  - b. Subject temperature sensor to temperature approximately 3 deg F below freeze-protection set point (initial set point 41 deg F). Monitor sensed temperature with a calibration-grade thermometer. Gradually change set point or sensed temperature until freeze-protection circuit is de-energized.
  - c. Simulate an electrical fault on the heating cable.
5. Acceptance Criteria:
  - a. Freeze-protection circuit is energized at set-point temperature of minus 2 deg F.
  - b. Freeze-protection circuit is de-energized at set-point temperature of plus 2 deg F.
  - c. Heater trace circuit controller initiates an alarm of cable fault. Alarm is correctly reported at the fire-alarm control panel.

### 3.7 Cx TESTS FOR COMPRESSED-AIR SYSTEMS

#### A. Air Compressor Run Time:

1. Prerequisites:
  - a. Acceptance of results of construction checklists specified in the following:
    - 1) Section 221519 "General-Service Packaged Air Compressors and Receivers."
    - 2) Section 226119 "Compressed-Air Equipment for Laboratory and Healthcare Facilities."
2. Test Scope:
  - a. Air compressors in plumbing systems.
  - b. Associated compressed-air piping, valves, and appurtenances.
  - c. Associated air pressure controllers.
3. Test Purpose: Evaluate air compressor run time and number of compressor starts.
4. Test Conditions:
  - a. Keep compressed air openings closed during test.
  - b. For systems with multiple compressors, lock out compressor motors on all but one compressor. Repeat test for each compressor in turn.
  - c. Record number of air compressor motor starts during a 14-day period.

- d. Record air compressor motor run time during the same 14-day period.
- 5. Acceptance Criteria:
  - a. Number of compressor motor starts during test period shall not exceed 20.
  - b. Compressor motor run time during test period shall not exceed 60 minutes.

END OF SECTION 220800



## SECTION 220800 - COMMISSIONING OF PLUMBING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes Cx process requirements for the following plumbing systems, assemblies, and equipment:
  - 1. Domestic hot- and cold-water piping.
  - 2. Sanitary waste and vent piping.
  - 3. Storm drainage piping.
  - 4. Plumbing pumps.
  - 5. General-service compressed-air piping and equipment.
  - 6. Plumbing equipment.
- B. Related Requirements:
  - 1. Section 019113 "General Commissioning Requirements" for general Cx process requirements and CxA responsibilities.
  - 2. For construction checklists, comply with requirements in various Division 22 Sections specifying plumbing systems, system components, equipment, and products.

#### 1.2 DEFINITIONS

- A. Cx: Commissioning, as defined in Section 019113 "General Commissioning Requirements."

- B. CxA: Commissioning Authority, as defined in Section 019113 "General Commissioning Requirements."
- C. IAPMO: International Association of Plumbing and Mechanical Officials.
- D. IgCC: International Green Construction Code.
- E. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, subsystems, equipment, and components.

### 1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For plumbing testing technician.
- B. Construction Checklists:
  - 1. Draft Cx plan, including draft construction checklists to be prepared by CxA under Section 019113 "General Commissioning Requirements." Contractor is to review Construction Checklist in accordance with requirements in Section 019113 "General Commissioning Requirements" and ASHRAE 202 and to resolve any issues with the CxA.
  - 2. Cx plan, including material, installation, and performance construction checklists for systems, assemblies, subsystems, equipment, and components relating to plumbing to be part of the Cx process and in accordance with requirements in Section 019113 "General Commissioning Requirements" and ASHRAE 202.
- C. Test Equipment and Instruments: For all test equipment and instruments to be used in conducting Cx tests by Contractor, provide the following:
  - 1. Equipment/instrument identification number.
  - 2. Planned Cx application or use.
  - 3. Manufacturer, make, model, and serial number.
  - 4. Calibration history, including certificates from agencies that calibrate the equipment and instrumentation.

5. Equipment manufacturers' proprietary instrumentation and tools. For each instrument or tool, identify the following:
  - a. Instrument or tool identification number.
  - b. Equipment schedule designation of equipment for which the instrument or tool is required.
  - c. Manufacturer, make, model, and serial number.
  - d. Calibration history, including certificates from agencies that calibrate the instrument or tool, where appropriate.

#### 1.4 QUALITY ASSURANCE

- A. Plumbing Testing Technician Qualifications: Technicians to perform plumbing Construction Checklist verification tests. Construction Checklist verification test demonstrations, Cx tests, and Cx test demonstrations shall have the following minimum qualifications:
  1. Journey level or equivalent skill level with knowledge of plumbing system, electrical concepts, and building operations.
  2. Minimum three years' experience installing, servicing, and operating systems manufactured by approved manufacturer.
- B. Testing Equipment and Instrumentation Quality and Calibration:
  1. Capable of testing and measuring performance within the specified acceptance criteria.
  2. Be calibrated at manufacturer's recommended intervals with current calibration tags permanently affixed to the instrument being used.
  3. Be maintained in good repair and operating condition throughout duration of use on Project.
  4. Be recalibrated/repared if dropped or damaged in any way since last calibrated.
- C. Proprietary Test Instrumentation and Tools:
  1. Equipment Manufacturer's Proprietary Instrumentation and Tools: For installed equipment included in the Cx process, test instrumentation and tools manufactured or prescribed by equipment manufacturer to service, calibrate, adjust, repair, or otherwise work on its equipment or required as a condition of equipment warranty, shall comply with the following:
    - a. Be calibrated by manufacturer with current calibration tags permanently affixed.
    - b. Include a separate list of proprietary test instrumentation and tools in operation and maintenance manuals.
    - c. Plumbing system proprietary test instrumentation and tools become property of Owner at the time of Substantial Completion.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 Cx PROCESS

- A. Perform Cx process for plumbing systems in accordance with:
  - 1. IgCC, which requires compliance with ASHRAE 202.

3.2 CONSTRUCTION CHECKLISTS

- A. Preliminary detailed construction checklists are to be prepared under Section 019113 "General Commissioning Requirements" for each plumbing system, assembly, subsystem, equipment, and component required to be commissioned, as detailed in IgCC. Contractor performs the following:
  - 1. Review plumbing preliminary construction checklists and provide written comments on Construction Checklist items where appropriate.
  - 2. Return preliminary Construction Checklist with review comments within 10 days of receipt.
  - 3. When review comments have been resolved, the CxA will provide final construction checklists marked "Approved for Use, (date)."
  - 4. Use only construction checklists marked "Approved for Use, (date)." Mark construction checklists in the appropriate place, as indicated Project events are completed, and provide pertinent details and other information.
- B. Prepare preliminary detailed construction checklists for each plumbing system, assembly, subsystem, equipment, and component required to be commissioned, as detailed in IgCC.
  - 1. Submit preliminary construction checklists to CxA and Designer for review.
  - 2. When review comments have been resolved, the CxA will provide final construction checklists marked "Approved for Use, (date)."
  - 3. Use only construction checklists marked "Approved for Use, (date)." Mark construction checklists in the appropriate place as indicated Project events are completed, and provide pertinent details and other information.
- C. Systems Required to Be Commissioned under IgCC:

1. Domestic hot-water systems and controls.
2. Water-pumping and -mixing systems over 5 hp and purification systems.
3. Renewable energy systems and energy storage systems.

D. Additional Systems Required to Be Commissioned:

1. Domestic water piping, including the following:
  - a. Domestic cold- and hot-water piping, fittings, and specialties inside the building.
  - b. Pumps, motors, accessories, and controls.
  - c. Sleeves and sleeve seals.
  - d. Indoor water-storage tanks.
  - e. Meters and gauges.
  - f. General-duty and specialty valves.
  - g. Hangers and supports.
  - h. Heat tracing.
  - i. Vibration isolation.
2. Sanitary waste and vent piping, including the following:
  - a. Gravity and forced-main sewerage piping, fittings, and specialties.
  - b. Sanitary waste interceptors.
  - c. Pumps, motors, accessories, and controls.
  - d. Drains.
  - e. Sleeves and sleeve seals.
  - f. Meters and gauges.
  - g. General-duty and specialty valves.
  - h. Hangers and supports.
  - i. Heat tracing.
  - j. Vibration isolation.
3. Storm-water piping, including the following:
  - a. Drainage piping, fittings, and specialties.
  - b. Pumps, motors, accessories, and controls.
  - c. Drains and collection basins.
  - d. Rainwater-collection and storage equipment.
  - e. Sleeves and sleeve seals.
  - f. Meters and gauges.
  - g. General-duty and specialty valves.
  - h. Hangers and supports.
  - i. Heat tracing.
  - j. Vibration isolation.
4. Plumbing fixtures, including the following:
  - a. Water closets, supports and connections, supplies, and flush valves.
  - b. Urinals, supports and connections, supplies, and flush valves.

- c. Lavatories, supports, supplies, drain connections, and faucets.
  - d. Sinks, supports, supplies, drain connections, and faucets.
  - e. Tubs, drain connections, and faucets.
  - f. Showers, supplies, drain connections, and faucets.
  - g. Wash fountains, supplies, drain connections, and faucets.
  - h. Emergency plumbing fixtures, supplies, drain connections, and controls.
  - i. Drinking fountains, supplies, and drainage connections.
5. General-service compressed-air piping, including the following:
- a. Piping, fittings, and specialties inside the building.
  - b. Compressors, motors, accessories, and controls.
  - c. Compressed-air outlets and connections.
  - d. Sleeves and sleeve seals.
  - e. Meters and gauges.
  - f. General-duty and specialty valves.
  - g. Hangers and supports.
  - h. Vibration isolation.

### 3.3 Cx TESTING PREPARATION

- A. Certify that plumbing systems, subsystems, and equipment have been installed, calibrated, and started and that they are operating in accordance with the Contract Documents and approved submittals.
- B. Certify that plumbing system instrumentation and control systems have been completed and calibrated, point-to-point checkout has been successfully completed, and systems are operating in accordance with their design sequence of operation, Contract Documents, and approved submittals. Certify that all sensors are operating within specified accuracy and that all systems are set to and maintaining set points as required by the design documents.
- C. Set systems, subsystems, and equipment into operating mode to be tested in accordance with approved test procedures (for example, normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

### 3.4 Cx TEST CONDITIONS

- A. Perform tests using design conditions, whenever possible.
  - 1. Simulated conditions may, with approval of Architect, be imposed using an artificial load when it is impractical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by CxA, and document simulated conditions and methods of simulation. After tests, return configurations and settings to normal operating conditions.
  - 2. Cx test procedures may direct that set points be altered when simulating conditions is impractical.
  - 3. Cx test procedures may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are impractical.

- B. If tests cannot be completed because of a deficiency outside the scope of the plumbing system, document the deficiency and report it to Architect. After deficiencies are resolved, reschedule tests.
- C. If seasonal testing is specified, complete appropriate initial performance tests and documentation and schedule seasonal tests.

### 3.5 Cx TESTS COMMON TO PLUMBING SYSTEMS

- A. Measure capacities and effectiveness of systems, assemblies, subsystems, equipment, and components, including operational and control functions, to verify compliance with acceptance criteria.
- B. Test systems, assemblies, subsystems, equipment, and components for operating modes, interlocks, control responses, responses to abnormal or emergency conditions, and response compared to acceptance criteria.
- C. Coordinate schedule with, and perform Cx activities at the direction of, CxA.
- D. Comply with Construction Checklist requirements, including material verification, installation checks, startup, and performance test requirements specified in Division 22 Sections specifying plumbing systems and equipment.
- E. Provide technicians, instrumentation, tools, and equipment to perform and document the following:
  - 1. Cx Construction Checklist verification tests.
  - 2. Cx Construction Checklist verification test demonstrations.

### 3.6 CONSTRUCTION CHECKLIST EXAMPLES

- A. Vibration Isolation in Plumbing Systems:
  - 1. Prerequisites: Acceptance of results of construction checklists for vibration control devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."
  - 2. Components to Be Tested:
    - a. Vibration isolation control devices in plumbing systems.
    - b. Support systems.
  - 3. Test Purpose: Evaluate effectiveness of vibration isolation control devices.
  - 4. Test Conditions: Measure vibration of the facility structure at three locations designated by Owner's witness at the following operating conditions:

- a. Maximum speed.
    - b. Minimum speed.
    - c. Critical speed.
  5. Acceptance Criteria: Structure-borne vibration not to exceed specified performance.
- B. Supervision of Alarms in Plumbing Systems:
1. Prerequisites: Acceptance of results of construction checklists for plumbing systems specified in the following Sections:
    - a. Section 221429 "Sump Pumps."
    - b. Section 223400 "Fuel-Fired, Domestic-Water Heaters."
    - c. Section 226113 "Compressed-Air Piping for Laboratory and Healthcare Facilities."
    - d. Section 226313 "Gas Piping for Laboratory and Healthcare Facilities."
    - e. Section 331415 "Site Water Distribution Piping."
  2. Test Scope:
    - a. Monitored plumbing system alarms.
  3. Test Purpose:
    - a. Verify reporting of supervised plumbing alarm at building management system.
  4. Test Conditions:
    - a. Alarm monitoring systems operating in normal, automatic mode.
    - b. Activate supervised plumbing alarms, one at a time.
  5. Acceptance Criteria:
    - a. Activation of supervised plumbing alarm generates alarm at building management system control panel.
- C. Plumbing Meter Reporting:
1. Prerequisites: Acceptance of results of construction checklists for plumbing systems specified in the following Sections :
    - a. Section 221119 "Domestic Water Piping Specialties."



- b. Section 223100 "Domestic Water Softeners."
  - c. Section 331415 "Site Water Distribution Piping."
- 2. Test Scope:
  - a. Supervised plumbing system water meters.
- 3. Test Purpose:
  - a. Verify accuracy of reporting of supervised plumbing system water meters at building management system.
- 4. Test Conditions:
  - a. Plumbing system water meter recording systems operating in normal, automatic mode.
  - b. Compare cumulative consumption data at plumbing system water meter recording systems with independent, calibrated, flow-measuring instrumentation under the following conditions:
    - 1) Low Flow: 1 percent of maximum design flow rate for a period of four hours.
    - 2) High Flow: 80 percent of maximum design flow rate for a period of 20 minutes.
  - c. Activate supervised plumbing alarms, one at a time.
- 5. Acceptance Criteria:
  - a. Cumulative flow reported for low-flow condition is within 5 percent flow recorded by calibrated flow-measuring instrumentation.
  - b. Cumulative flow reported for high-flow condition is within 1 percent flow recorded by calibrated flow-measuring instrumentation.
- D. Heat Tracing in Plumbing Systems:
  - 1. Prerequisites: Acceptance of results of construction checklists for heat tracing specified in heat-tracing systems. Comply with requirements listed in Section 220533 "Heat Tracing for Plumbing Piping."
  - 2. Equipment and Systems To Be Tested:
    - a. Self-regulating, parallel-resistance heating cables.
    - b. Heater trace circuit controller.
  - 3. Test Purpose:
    - a. Evaluate response to ambient temperature below freeze-protection set point.
    - b. Evaluate heating cable fault alarm.
  - 4. Test Conditions:

- a. Subject temperature sensor to temperature approximately 3 deg F above freeze-protection set point (initial set point 41 deg F). Monitor sensed temperature with a calibration-grade thermometer. Gradually change set point or sensed temperature until freeze-protection circuit is energized.
  - b. Subject temperature sensor to temperature approximately 3 deg F below freeze-protection set point (initial set point 41 deg F). Monitor sensed temperature with a calibration-grade thermometer. Gradually change set point or sensed temperature until freeze-protection circuit is de-energized.
  - c. Simulate an electrical fault on the heating cable.
5. Acceptance Criteria:
- a. Freeze-protection circuit is energized at set-point temperature of minus 2 deg F.
  - b. Freeze-protection circuit is de-energized at set-point temperature of plus 2 deg F.
  - c. Heater trace circuit controller initiates an alarm of cable fault. Alarm is correctly reported at the fire-alarm control panel.

### 3.7 Cx TESTS FOR COMPRESSED-AIR SYSTEMS

#### A. Air Compressor Run Time:

1. Prerequisites:
  - a. Acceptance of results of construction checklists specified in the following:
    - 1) Section 221519 "General-Service Packaged Air Compressors and Receivers."
    - 2) Section 226119 "Compressed-Air Equipment for Laboratory and Healthcare Facilities."
2. Test Scope:
  - a. Air compressors in plumbing systems.
  - b. Associated compressed-air piping, valves, and appurtenances.
  - c. Associated air pressure controllers.
3. Test Purpose: Evaluate air compressor run time and number of compressor starts.
4. Test Conditions:
  - a. Keep compressed air openings closed during test.
  - b. For systems with multiple compressors, lock out compressor motors on all but one compressor. Repeat test for each compressor in turn.
  - c. Record number of air compressor motor starts during a 14-day period.
  - d. Record air compressor motor run time during the same 14-day period.
5. Acceptance Criteria:
  - a. Number of compressor motor starts during test period shall not exceed 20.
  - b. Compressor motor run time during test period shall not exceed 60 minutes.

END OF SECTION 220800

**SECTION 22 11 00**  
**WATER DISTRIBUTION**

**PART 1 - GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions and Special Conditions, apply to this Section.
- B. "Standard Specifications" shall mean the State of New York Department of Transportation Standard Specifications, May 1, 2024, its latest edition and any supplemental specifications.
- C. Standard specifications and requirements of the United Water Company, inclusive of all supplements and/or its latest revision or edition. These specifications have been referred to herein, however, other requirements may apply.
- D. Standard Details of United Water, inclusive of all supplements and/or its latest revision or edition.

**1.02 SECTION INCLUDES**

- A. New water service including new pipe material, connections, tees, fittings, valves, etc.
- B. Testing, inspection, and disinfection requirements.
- C. Abandonment of existing water service connections.

**1.03 QUALITY ASSURANCE**

- A. All water service piping and appurtenances shall be constructed in accordance with the standards and specifications of United Water (UW), as applicable. Contact UW to arrange inspection services as required prior to installation.
- B. Submit shop drawings for approval for all water products as specified herein.
- C. All materials and labor for water main taps to connection to valve box shall be provided by United Water (UW).
- D. The substitution of equivalent materials not specified herein, must be applied for in writing stating the materials requested to be used and accompanied by the manufacturer's engineering transmittal drawings, written confirmation from reputable suppliers of availability of repair parts, replacement parts and repair services where applicable, and test data for review by United Water, whose decision shall be final.

**1.04 PROJECT CONDITIONS**

- A. Coordinate with United Water for connection to existing water main.

#### 1.05 SUBMITTALS

- A. Submit Shop Drawings or descriptive literature, or both, showing dimensions, joints and other details of all materials to be furnished. Shop Drawings shall be submitted to the Engineer for approval prior to ordering materials.
- B. As-Built Drawings shall be complete and shall indicate the true measurements and locations, horizontal and vertical, of all new construction. As-Built Drawings shall include a minimum of three ties to each gate valve box from fixed permanent objects. As-Built Drawings shall also contain any additional information required by the municipality, and shall be stamped with the seal of a Licensed Land Surveyor and Licensed Professional Engineer

### PART 2 - PRODUCTS

#### 2.01 DUCTILE IRON PIPE AND FITTINGS

- A. AWWA C151, Class 56. Fittings shall be ductile iron or cast iron, AWWA C110, 250 PSI, mechanical joint or AWWA C153, ductile iron compact fittings, 350 PSI, mechanical joint.
- B. Lining: AWWA C104, cement mortar, seal coated.
- C. Gaskets: AWWA C111, rubber.
- D. Encasement: AWWA C105, polyethylene film tube.

#### 2.02 SERVICE VALVES

- A. Valves shall conform to the latest revision of AWWA C509. Interior and exterior fusion bonded epoxy coating shall conform to the latest revision of AWWA Standard C-550. Non-buried service valves will have an operating wheel.

#### 2.03 VALVE BOXES

- A. Valve boxes for larger than 2-½ inch curb valves should be of the Buffalo Type with 5-¼ inch diameter shaft.
- B. All valve boxes should be of cast iron and fitted with a cast iron cover marked with the word "WATER" and installed with the cover flush with the finished grade.
- C. Plastic valve boxes and valve box covers are prohibited.

#### 2.04 TEES AND FITTINGS

- A. Tees and fittings shall be compatible for use with Type K copper pipe.

#### 2.05 OTHER

- A. Warning tape shall be plastic or metalized plastic, blue in color, a minimum of four (4) inches in width and have the words "CAUTION – WATER LINE BURIED BELOW" imprinted on it in black letters.

- B. Trace wire will be made of Copper 18 Gauge.
  - C. Backflow prevention device (BFP) will be manufactured in accordance with the latest revision of AWWA Standard C511 and pre-approved for use by United Water.
- 2.06 FIRE HYDRANT: Coordinate the removal and re-installation of fire hydrant with the City of Rye.
- 2.07 GENERAL: The Drawings are diagrammatic only and are intended to indicate the extent, but not all details, of the system which shall be constructed. All materials are not shown; but the Contractor shall furnish and install all materials required for the complete system.

### **PART 3 - EXECUTION**

#### **3.1 TRENCHING**

- A. Sawcutting, trenching, bedding and backfilling are covered under Section 02325 "Trenching."
- B. Minimum cover over pipe shall be four (4) feet deep – **NO EXCEPTIONS**. ALL SERVICES SHALL BE INSPECTED BY UW BEFORE THEY ARE BACKFILLED. Services not visually inspected shall be pressure tested before the meter is set. The test will check to see if the service can hold the distribution systems static pressure.

#### **3.2 INSTALLING PIPE**

- A. Installation shall conform to United Water standard guidelines.
- B. Pipe shall be laid to the lines and grades approved. Water service line shall run perpendicular to the water main from top to curb valve and in a straight line from the curb valve to the point of connection. Any necessary bends shall be of standard angles, with proper fittings. Where the pipe crosses existing utilities, a minimum vertical clearance of 12 inches shall be maintained, except for storm and sanitary sewer pipes, where a minimum vertical clearance of 18" shall be maintained. A minimum horizontal distance of 12-18 inches shall be maintained at all times between the water pipe and sewer pipe. Water pipe shall be laid at least 5 feet away from electric lines and natural gas lines, and shall be 10 feet from leaching fields, oil tanks, gas tanks and any associated lines.
- C. In accordance with current state laws, rules and regulations, metallic warning tape is required on all water service installations. Warning tape will be installed no less than 12 inches and no more than 18 inches above each service pipe.

#### **3.3 DISINFECTION AND PRESSURE TESTING**

- A. All water service pipes shall be leakage tested by the installer according United Water's rules and regulations.
- B. All water pipe shall be disinfected by the installer according to United Water's rules and regulations.

- C. It shall be the contractor's responsibility to dispose of all chlorinated water used to disinfect a water main. This shall be accomplished in accordance with the federal Clean Water Act and New York State D.E.C. standards for disposal. It may involve running the water through a burlap bag containing a de-chlorination agent. United Water must be notified prior to any de-chlorinating operations.

**END OF SECTION 22 11 00**

## SECTION 221116 - DOMESTIC WATER PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Copper tube and fittings - domestic water.
2. Piping joining materials - domestic water.
3. Encasement for piping.
4. Transition fittings - domestic water.
5. Dielectric fittings - domestic water.

B. Related Requirements:

1. Section 331415 "Site Water Distribution Piping" for water-service piping and water meters outside the building from source to the point where water-service piping enters the building.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Piping layout, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.
- B. System purging and disinfecting activities report.
- C. Field quality-control reports.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Installers of pressure-sealed joints are to be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.



## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Domestic water piping, tubing, fittings, joints, and appurtenances intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act, with requirements of authorities having jurisdiction, and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

## 2.2 PIPING MATERIALS

- A. Potable-water piping and components are to comply with NSF 14, NSF 61, and NSF 372. Include marking "NSF-pw" on piping.

## 2.3 COPPER TUBE AND FITTINGS - DOMESTIC WATER

- A. Drawn-Temper Copper Tube: ASTM B88, Type L.
- B. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings. Do not use solder joints on pipe sizes greater than NPS 4.
- C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings. Do not use solder joints on pipe sizes greater than NPS 4.
- D. Cast Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends. Do not use solder joints on pipe sizes greater than NPS 4.
- E. Wrought Copper Unions: ASME B16.22. Do not use solder joints on pipe sizes greater than NPS 4.

F. Pressure-Seal-Joint Fittings, Copper or Bronze - Domestic Water:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - b. Elkhart Brass Mfg. Co., Inc.
  - c. Mueller Streamline Co.; a company of Mueller Industries.
  - d. NIBCO INC.
  - e. Viega LLC.
2. Source Limitations: Obtain pressure-seal-joint fittings, copper or bronze, from single manufacturer.
3. Housing: Copper.
4. O-Rings and Pipe Stops: EPDM.
5. Tools: Manufacturer's special tools.
6. Minimum 200 psig working-pressure rating at 250 deg F.

2.4 PIPING JOINING MATERIALS - DOMESTIC WATER

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B32, lead-free alloys.

D. Flux: ASTM B813, water flushable.

E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.5 ENCASEMENT FOR PIPING

- A. Standard: ASTM A674 or AWWA C105/A21.5.
- B. Form: Sheet or tube.
- C. Color: Black or natural.

2.6 TRANSITION FITTINGS - DOMESTIC WATER

- A. General Requirements:
  - 1. Same size as pipes to be joined.
  - 2. Pressure rating at least equal to pipes to be joined.
  - 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Sleeve-Type Transition Couplings - Domestic Water: AWWA C219.
  - 1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
  - 2. Source Limitations: Obtain sleeve-type transition couplings from single manufacturer.

2.7 DIELECTRIC FITTINGS - DOMESTIC WATER

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions - Domestic Water:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. A.Y. McDonald Mfg. Co.
    - b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
    - c. HART Industrial Unions, LLC.
    - d. Jomar Valve.
    - e. Matco-Norca.
    - f. WATTS; A Watts Water Technologies Company.
    - g. Zurn Industries, LLC.
  - 2. Source Limitations: Obtain dielectric unions from single manufacturer.
  - 3. Standard: ASSE 1079.

4. Pressure Rating: 150 psig.
5. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges - Domestic Water:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Capitol Manufacturing Company.
  - b. GF Piping Systems: Georg Fischer LLC.
  - c. Matco-Norca.
  - d. WATTS; A Watts Water Technologies Company.
  - e. Zurn Industries, LLC.
2. Source Limitations: Obtain dielectric flanges from single manufacturer.
3. Standard: ASSE 1079.
4. Factory-fabricated, bolted, companion-flange assembly.
5. Pressure Rating: 150 psig.
6. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits - Domestic Water:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Advance Products & Systems, LLC.
  - b. CALPICO, Inc.
  - c. GPT; a division of EnPRO Industries.
2. Source Limitations: Obtain dielectric-flange insulating kits from single manufacturer.
3. Nonconducting materials for field assembly of companion flanges.
4. Pressure Rating: 150 psig.
5. Gasket: Phenolic, Temperature Rating: 225 deg F.
6. Bolt Sleeves: Phenolic or polyethylene.
7. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples - Domestic Water:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Anvil; an ASC Engineered Solution.
  - b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - c. Matco-Norca.
  - d. Sioux Chief Manufacturing Company, Inc.
  - e. Victaulic Company.
2. Source Limitations: Obtain dielectric nipples from single manufacturer.
3. Standard: IAPMO PS 66.
4. Electroplated steel nipple complying with ASTM F1545.
5. Pressure Rating and Temperature: 300 psig at 225 deg F.
6. End Connections: Male threaded or grooved.
7. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Aboveground domestic water piping, NPS 3 and smaller is to be the following:
  1. Drawn-temper copper tube, ASTM B88, Type L; wrought-copper, solder-joint fittings; and soldered joints.
  2. Drawn-temper copper tube, ASTM B88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.

### 3.2 EARTHWORK

- A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

### 3.3 INSTALLATION OF PIPING

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab in accordance with CDA's "Copper Tube Handbook."
- C. Install underground copper tube in PE encasement in accordance with ASTM A674 or AWWA C105/A21.5.
- D. Install valves in accordance with Section 220523 "General-Duty Valves for Plumbing Piping."
- E. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."
- F. Install domestic water piping level without pitch and plumb.
- G. Rough-in domestic water piping for water-meter installation in accordance with utility company's requirements.
- H. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- I. 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.
- J. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- K. Install piping to permit valve servicing.

- L. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- M. Install piping free of sags and bends.
- N. Install fittings for changes in direction and branch connections.
- O. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- P. Install pressure gauges on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gauges in Section 220500 "Common Work Results for Plumbing."
- Q. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123.21 "Inline, Domestic Water Pumps."
- R. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 220500 "Common Work Results for Plumbing."
- S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220500 "Common Work Results for Plumbing."
- T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220500 "Common Work Results for Plumbing."
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220500 "Common Work Results for Plumbing."

### 3.4 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.



- D. Soldered Joints for Copper Tubing: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings in accordance with ASTM B828 or CDA's "Copper Tube Handbook."
- E. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools and procedure recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.
- F. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

### 3.5 INSTALLATION OF TRANSITION FITTINGS

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
  - 1. Fittings for NPS 1-1/2 (DN 40) and Smaller: Fitting-type coupling.
  - 2. Fittings for NPS 2 (DN 50) and Larger: Sleeve-type coupling.

### 3.6 INSTALLATION OF DIELECTRIC FITTINGS

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric couplings or nipples.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flanges.
- D. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

### 3.7 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for hangers, supports, and anchor devices in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Install hangers for copper and stainless steel tube and pipe, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- C. Support horizontal piping within 12 inches of each fitting.
- D. Support vertical runs of copper and stainless steel tube and pipe to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

### 3.8 PIPING CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
  - 1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
  - 2. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
  - 3. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

### 3.9 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

### 3.10 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
  - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
  - 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
    - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    - b. Fill and isolate system in accordance with either of the following:
      - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
      - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

- c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
  - d. Repeat procedures if biological examination shows contamination.
  - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

### 3.11 ADJUSTING

- A. Perform the following adjustments before operation:
  - 1. Close drain valves, hydrants, and hose bibbs.
  - 2. Open shutoff valves to fully open position.
  - 3. Open throttling valves to proper setting.
  - 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
    - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
    - b. Adjust calibrated balancing valves to flows indicated.
  - 5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
  - 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
  - 7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
  - 8. Check plumbing specialties and verify proper settings, adjustments, and operation.

### 3.12 FIELD QUALITY CONTROL

- A. Tests and Inspections:
  - 1. Piping Inspections:
    - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
    - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

- 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after installation and before setting fixtures.
  - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
- c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
  - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
2. Piping Tests:
- a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
  - b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
  - c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  - d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
  - e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
  - f. Prepare reports for tests and for corrective action required.
- B. Domestic water piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 221116

## SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated, water mixing valves.
6. Strainers for domestic water piping.
7. Hose bibbs.
8. Wall hydrants.
9. Drain valves.
10. Water-hammer arresters.
11. Flexible connectors.
12. Water meters.

##### B. Related Requirements:

1. Section 220500 "Common Work Results for Plumbing."
2. Section 221116 "Domestic Water Piping" for water meters.
3. Section 224500 "Emergency Plumbing Fixtures" for water tempering equipment.
4. Section 224700 "Drinking Fountains and Water Coolers."
5. Section 331415 "Site Water Distribution Piping" for fire water-service backflow prevention devices.

#### 1.2 DEFINITIONS

A. AMI: Advanced Metering Infrastructure.

B. AMR: Automatic Meter Reading.

- C. FKM: A family of fluoroelastomer materials defined by ASTM D1418.

### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For domestic water piping specialties.
  - 1. Include diagrams for power, signal, and control wiring.

### 1.4 INFORMATIONAL SUBMITTALS

- A. Test and inspection reports.
- B. Field quality-control reports.

### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Domestic water piping specialties intended to convey or dispense water for human consumption are to comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or to be certified in compliance with NSF 61 and NSF 372 by an American National

Standards Institute (ANSI)-accredited third-party certification body that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

## 2.3 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - b. Cash Acme Plumbing Products; an RWC brand.
  - c. FEBCO; A WATTS Brand.
  - d. WATTS; A Watts Water Technologies Company.
  - e. Zurn Industries, LLC.
2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Chrome plated.

- B. Hose-Connection Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - b. Cash Acme Plumbing Products; an RWC brand.
  - c. WATTS; A Watts Water Technologies Company.
  - d. Zurn Industries, LLC.
2. Standard: ASSE 1011.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Chrome or nickel plated.

- C. Pressure Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - b. FEBCO; A WATTS Brand.

- c. WATTS; A Watts Water Technologies Company.
- d. Zurn Industries, LLC.
- 2. Standard: ASSE 1020.
- 3. Operation: Continuous-pressure applications.
- 4. Accessories:
  - a. Valves: Ball type, on inlet and outlet.

2.4 BACKFLOW PREVENTERS



A. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Ames Fire & Waterworks; A Watts Water Technologies Company.
  - b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - c. WATTS; A Watts Water Technologies Company.
  - d. Zurn Industries, LLC.
2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Body: Bronze for NPS 2 and smaller; stainless steel for NPS 2-1/2 and larger.
5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
6. Configuration: Designed for horizontal, straight-through flow.
7. Accessories:
  - a. Valves NPS 2 (DN 50) and Smaller: Ball type with threaded ends on inlet and outlet.
  - b. Valves NPS 2-1/2 (DN 65) and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
  - c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

2.5 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - b. Caleffi North America.
  - c. Cash Acme Plumbing Products; an RWC brand.
  - d. WATTS; A Watts Water Technologies Company.
  - e. Zurn Industries, LLC.
2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Body: Bronze for NPS 2 and smaller; bronze for NPS 2-1/2 and NPS 3.
5. Valves for Booster Heater Water Supply: Include integral bypass.
6. End Connections: Threaded or solder for NPS 2 and smaller; flanged or solder for NPS 2-1/2 and NPS 3.

2.6 BALANCING VALVES

A. Automatic Flow Control Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Caleffi North America.
  - b. IMI Hydronic Engineering Inc.
  - c. ThermOmegaTech.
2. Flow Regulation: Plus or minus 5 percent over 95 percent of the working range.
3. Pressure Rating: 200 psig.
4. Size: NPS 2 or smaller.
5. Body: Stainless steel or brass.
6. Flow Cartridge: Stainless steel or antiscaling polymer.
7. End Connections: Threaded or solder joint.

## 2.7 TEMPERATURE-ACTUATED, WATER MIXING VALVES

### A. Primary, Thermostatic, Water Mixing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Acorn Engineering Company; a Division of Morris Group International.
  - b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - c. Caleffi North America.
  - d. Cash Acme Plumbing Products; an RWC brand.
  - e. Lawler Manufacturing Company, Inc.
  - f. POWERS; A Watts Water Technologies Company.
  - g. Symmons Industries, Inc.
  - h. WATTS; A Watts Water Technologies Company.
  - i. Zurn Industries, LLC.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Type: Exposed-mounted, thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: 120 deg F.
9. Valve Finish: Chrome plated.
10. Piping Finish: Chrome plated.

### B. Individual-Fixture, Water Tempering Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Acorn Engineering Company; a Division of Morris Group International.
  - b. Caleffi North America.
  - c. Lawler Manufacturing Company, Inc.

- d. POWERS; A Watts Water Technologies Company.
  - e. Zurn Industries, LLC.
- 
- 2. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
  - 3. Pressure Rating: 125 psig minimum unless otherwise indicated.
  - 4. Material: Bronze body with corrosion-resistant interior components.
  - 5. Temperature Control: Adjustable.
  - 6. Connections: Threaded inlets and outlet.
  - 7. Finish: Chrome plated.
  - 8. Tempered-Water Setting: 90 deg F.

## 2.8 STRAINERS FOR DOMESTIC WATER PIPING

### A. Y-Pattern Strainers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Keckley Company.
  - b. Titan Flow Control, Inc.
  - c. WATTS; A Watts Water Technologies Company.
  - d. Zurn Industries, LLC.
2. Pressure Rating: 125 psig minimum unless otherwise indicated.
3. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
4. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
5. Screen: Stainless steel with round perforations unless otherwise indicated.
6. Perforation Size:
  - a. Strainers NPS 2 (DN 50) and Smaller: 0.033 inch.
  - b. Strainers NPS 2-1/2 to NPS 4 (DN 65 to DN 100): 0.045 inch.
  - c. Strainers NPS 5 (DN 125) and Larger: 0.125 inch.
7. Drain: Factory-installed, hose-end drain valve.

## 2.9 HOSE BIBBS

### A. Hose Bibbs:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Jay R. Smith Mfg Co; a division of Morris Group International.
  - b. MIFAB, Inc.
  - c. WATTS; A Watts Water Technologies Company.
  - d. Woodford Manufacturing Company.
  - e. Zurn Industries, LLC.
2. Standard: ASME A112.18.1 for sediment faucets.
3. Body Material: Bronze.
4. Seat: Bronze, replaceable.
5. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
7. Pressure Rating: 125 psig.
8. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
9. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
10. Finish for Service Areas: Chrome or nickel plated.

11. Finish for Finished Rooms: Chrome or nickel plated.
12. Operation for Equipment Rooms: Wheel handle or operating key.
13. Operation for Service Areas: Wheel handle.
14. Operation for Finished Rooms: Operating key.
15. Include operating key with each operating-key hose bibb.
16. Include integral wall flange with each chrome- or nickel-plated hose bibb.

## 2.10 WALL HYDRANTS

### A. Nonfreeze Wall Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Jay R. Smith Mfg Co; a division of Morris Group International.
  - b. MIFAB, Inc.
  - c. Murdock Manufacturing; A Division of Morris Group International.
  - d. WATTS; A Watts Water Technologies Company.
  - e. Woodford Manufacturing Company.
  - f. Zurn Industries, LLC.
2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.

5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 or NPS 1.
7. Outlet, Concealed: With integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounted with cover.
9. Box and Cover Finish: Polished nickel bronze.
10. Outlet, Exposed: With integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
11. Nozzle and Wall-Plate Finish: Polished nickel bronze.
12. Operating Keys(s): Two with each wall hydrant.

## 2.11 DRAIN VALVES

### A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

## 2.12 WATER-HAMMER ARRESTERS

### A. Water-Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AMTROL, Inc.
  - b. Precision Plumbing Products.
  - c. Sioux Chief Manufacturing Company, Inc.
  - d. WATTS; A Watts Water Technologies Company.
  - e. Zurn Industries, LLC.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Piston.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

## 2.13 FLEXIBLE CONNECTORS

### A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flex-Hose Co., Inc.
2. Mason Industries, Inc.
3. Metraflex Company (The).

### B. Stainless Steel-Hose Flexible Connectors: Corrugated-stainless steel tubing with stainless steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig.
2. End Connections NPS 2 (DN 50) and Smaller: Threaded steel-pipe nipple.
3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged steel nipple.

## 2.14 WATER METERS

A. Turbine-Type Water Meters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Badger Meter, Inc.
  - b. Mueller Systems, LLC; a subsidiary of Mueller Water Products, Inc.
  - c. Neptune Technology Group Inc.
2. Standard: AWWA C701.
3. Pressure Rating: 150 psig working pressure.
4. Body Design: Turbine; totalization meter.
5. Registration: In gallons or cubic feet as required by utility company.
  - a. Remote Registration System: Encoder type complying with AWWA C707; modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.
    - 1) System to be capable of transmitting data using AMR/AMI technology.
6. Case: Bronze.
7. End Connections: Threaded or flanged.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING SPECIALTIES

- A. Backflow Preventers: Install in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
1. Locate backflow preventers in same room as connected equipment or system.
  2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe



diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.

3. Do not install bypass piping around backflow preventers.

- B. Water Regulators: Install with inlet and outlet shutoff valves. Install pressure gauges on inlet and outlet.
- C. Balancing Valves: Install in locations where they can easily be adjusted. Set at indicated design flow rates.
- D. Temperature-Actuated, Water Mixing Valves: Install with check stops or shutoff valves on inlets and with shutoff valve on outlet.
  1. Install cabinet-type units recessed in or surface mounted on wall as specified.
- E. Y-Pattern Strainers: For water, install on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.
- F. Water-Hammer Arresters: Install in water piping in accordance with PDI-WH 201.

### 3.2 PIPING CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.

### 3.3 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

### 3.4 CONTROL CONNECTIONS

- A. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

### 3.5 IDENTIFICATION

- A. Plastic Labels for Equipment: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
  - 1. Vacuum breakers.
  - 2. Backflow preventers.
  - 3. Water pressure-reducing valves.
  - 4. Balancing valves.
  - 5. Temperature-actuated, water mixing valves.
  - 6. Wall hydrants.
  - 7. Water meters.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

### 3.6 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.
- D. Adjust each pressure vacuum breaker, reduced-pressure-principle backflow preventer in accordance with manufacturer's written instructions, authorities having jurisdiction and the device's reference standard.

### 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 with the assistance of a factory-authorized service representative.
  - 1. Test each pressure vacuum breaker, reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.
  - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 3. Operational Test: After electrical circuitry has been energized, start units to confirm unit operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION 221119

## SECTION 221123.21 - INLINE, DOMESTIC-WATER PUMPS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. In-line, seal less centrifugal pumps.

#### 1.2 ACTION SUBMITTALS

##### A. Product Data: For each type of product.

1. Include construction materials, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.

#### 1.3 INFORMATIONAL SUBMITTALS

##### A. Coordination Drawings: Detail pumps and adjacent equipment. Show support locations, type of support, weight on each support, required clearances, and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Structural members to which pumps will be attached.
2. Size and location of initial access modules for acoustical tile.

- B. Seismic Qualification Data: Certificates, for inline, domestic-water pumps, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For inline, domestic-water pumps to include in operation and maintenance manuals.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.
- C. Comply with pump manufacturer's written instructions for handling.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. UL Compliance: UL 778 for motor-operated water pumps.

- C. Drinking Water System Components - Health Effects and Drinking Water System Components  
- Lead Content Compliance: NSF 61 and NSF 372.

## 2.2 IN-LINE, SEALLESS CENTRIFUGAL PUMPS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. GRUNDFOS CBS Inc.
  - 2. Taco Comfort Solutions.
  - 3. Bell and Gossett.
  - 4. WILO USA LLC - WILO Canada Inc.
- B. Description: Factory-assembled and -tested, in-line, close-coupled, canned-motor, sealless, overhung-impeller centrifugal pumps.
- C. Capacities and Characteristics: See schedule on drawings.
- D. Pump Construction:
  - 1. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge type with motor and impeller on common shaft and designed for installation with pump and motor shaft horizontal.
  - 2. Minimum Working Pressure: 125 psig.
  - 3. Maximum Continuous Operating Temperature: 220 deg F.
  - 4. Casing: Stainless steel, with threaded or companion-flange connections.
  - 5. Impeller: Plastic composite or stainless steel.
  - 6. Motor: Variable speed.

## 2.3 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220500 "Common Work Results for Plumbing."
  - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

## 2.4 CONTROLS

- A. Thermostats: Electric; adjustable for control of hot-water circulation pump.
  - 1. Type: Water-immersion temperature sensor, for installation in piping.
  - 2. Range: 65 to 200 deg F.
  - 3. Enclosure: NEMA 250, Type 4X.
  - 4. Operation of Pump: On or off.
  - 5. Transformer: Provide if required.
  - 6. Power Requirement: 120 V ac.
  - 7. Settings: Start pump at 115 deg F and stop pump at 120 deg F.
- B. Timers: Electric, for control of hot-water circulation pump.
  - 1. Type: Programmable, seven-day clock with manual override on-off switch.
  - 2. Enclosure: NEMA 250, Type 1, suitable for wall mounting.
  - 3. Operation of Pump: On or off.
  - 4. Transformer: Provide if required.
  - 5. Power Requirement: 120 V ac.
  - 6. Programmable Sequence of Operation: Up to two on-off cycles each day for seven days.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in for domestic-water-piping system to verify actual locations of piping connections before pump installation.

### 3.2 INSTALLATION OF PUMPS

- A. Comply with HI 1.4.
- B. Mount pumps in orientation complying with manufacturer's written instructions.
- C. Install continuous-thread hanger rods and vibration isolation of size required to support pump weight.

1. Comply with requirements for vibration isolation devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment." Fabricate brackets or supports as required.
  2. Comply with requirements for hangers and supports specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- D. Install pressure switches in water-supply piping.
- E. Install thermostats in hot-water return piping.
- F. Install timers on wall in engineer's office.
- G. Install time-delay relays in piping between water heaters and hot-water storage tanks.

### 3.3 PIPING CONNECTIONS

- A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to inline, domestic-water pumps, allow space for service and maintenance.
- C. Connect domestic-water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.
1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:
    - a. Horizontally mounted, in-line, separately coupled centrifugal pumps.
    - b. Horizontally mounted, in-line, close-coupled centrifugal pumps.
    - c. Vertically mounted, in-line, close-coupled centrifugal pumps.
    - d. Comply with requirements for flexible connectors specified in Section 221116 "Domestic Water Piping."
- D. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for strainers specified in Section 221119 "Domestic Water Piping Specialties." Comply with requirements for valves specified in Section 220523 "General-Duty Valves for Plumbing Piping."
1. Install pressure gauge and snubber at suction of each pump and pressure gauge and snubber at discharge of each pump. Install at integral pressure-gauge tapings where provided or install pressure-gauge connectors in suction and discharge piping around pumps. Comply with requirements for pressure gauges and snubbers specified in Section 220500 "Common Work Results for Plumbing."



### 3.4 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring between temperature controllers and devices.
- C. Interlock pump between water heater and hot-water storage tank with water heater burner and time-delay relay.

### 3.5 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment" for identification of pumps.

### 3.6 FIELD QUALITY CONTROL

- A. Testing Agency:
  - 1. Owner will engage a qualified testing agency to perform tests and inspections.
  - 2. Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections with the assistance of a factory-authorized service representative.
- D. Tests and Inspections:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Inline, domestic-water pump will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

### 3.7 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
  1. Complete installation and startup checks according to manufacturer's written instructions.
  2. Check piping connections for tightness.
  3. Clean strainers on suction piping.
  4. Set pressure switches, thermostats, timers, for automatic starting and stopping operation of pumps.
  5. Perform the following startup checks for each pump before starting:
    - a. Verify bearing lubrication.
    - b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
    - c. Verify that pump is rotating in the correct direction.
  6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
  7. Start motor.
  8. Open discharge valve slowly.
  9. Adjust temperature settings on thermostats.
  10. Adjust timer settings.

### 3.8 ADJUSTING

- A. Adjust inline, domestic-water pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust initial temperature set points.
- C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION 221123.21

## SECTION 221316 - SANITARY WASTE AND VENT PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Copper tube and fittings.
  - 2. PVC pipe and fittings.
  - 3. Specialty pipe fittings.
  - 4. Encasement for underground metal piping.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For hubless, single-stack drainage system. Include plans, elevations, sections, and details.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans and elevations, or Building Information Model (BIM) drawn to scale, showing items described in this Section and coordinated with all building trades.

- B. Field quality-control reports.

#### 1.4 WARRANTY

- A. Listed manufacturers to provide labeling and warranty of their respective products.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Components and installation are capable of withstanding the following minimum working pressure unless otherwise indicated:
  - 1. Soil, Waste, and Vent Piping: 10 ft. head of water.

#### 2.2 PIPING MATERIALS

- A. Piping materials to bear label, stamp, or other markings of specified testing agency.
- B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

## 2.3 COPPER TUBE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  2. Cambridge-Lee Industries, LLC.
  3. Cerro Flow Products, LLC.
  4. Wieland Copper Products, LLC.
- B. Copper Type DWV Tube: ASTM B306, drainage tube, drawn temper.
- C. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- D. Hard Copper Tube: ASTM B88, Type L and Type M, water tube, drawn temper.
- E. Soft Copper Tube: ASTM B88, Type L, water tube, annealed temper.
- F. Copper Pressure Fittings:
1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
  2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- G. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
  2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- H. Solder: ASTM B32, lead free with ASTM B813, water-flushable flux.

## 2.4 PVC PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  2. Charlotte Pipe and Foundry Company.
  3. GF Piping Systems.
  4. JM Eagle.
  5. National Pipe and Plastic, Inc.
  6. North America Pipe Corporation.
  7. Rocky Mountain Colby Pipe Company.
  8. Silver-line Plastics.

- B. Comply with NSF 14 for plastic piping components. Include "NSF-dwv" marking for plastic drain, waste, and vent piping and "NSF-sewer" marking for plastic sewer piping.
- C. Solid-Wall PVC Pipe: ASTM D2665 drain, waste, and vent.
- D. PVC Socket Fittings: ASTM D2665, made in accordance with ASTM D3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- E. Adhesive Primer: ASTM F656.
- F. Solvent Cement: ASTM D2564.

## 2.5 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
  - 1. General Requirements: Fitting or device for joining piping with small differences in ODs or of different materials. Include end connections of same size as and compatible with pipes to be joined.
  - 2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
  - 3. Unshielded, Nonpressure Transition Couplings:
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Dallas Specialty & Mfg. Co.
      - 2) Fernco Inc.
      - 3) Mission Rubber Company, LLC; a division of MCP Industries.
      - 4) Plastic Oddities.
    - b. Standard: ASTM C1173.

- c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
  - d. End Connections: Same size as and compatible with pipes to be joined.
  - e. Sleeve Materials:
    - 1) For Cast-Iron Soil Pipes: ASTM C564, rubber.
    - 2) For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926 PVC.
    - 3) For Dissimilar Pipes: ASTM D5926 PVC or other material compatible with pipe materials being joined.
4. Shielded, Nonpressure Transition Couplings:
- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Cascade Waterworks Mfg. Co.
    - 2) Mission Rubber Company, LLC; a division of MCP Industries.
  - b. Standard: ASTM C1460.
  - c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
  - d. End Connections: Same size as and compatible with pipes to be joined.
5. Pressure Transition Couplings:
- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Apollo Valves; a part of Aalberts Integrated Piping Systems.
    - 2) Cascade Waterworks Mfg. Co.
    - 3) EBAA Iron Sales, Inc.
    - 4) Ford Meter Box Company, Inc. (The).
    - 5) JCM Industries, Inc.
    - 6) Romac Industries, Inc.
  - b. Standard: AWWA C219.
  - c. Description: Metal sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
  - d. Center-Sleeve Material: Stainless steel.
  - e. Gasket Material: Natural or synthetic rubber.
  - f. Metal Component Finish: Corrosion-resistant coating or material.

B. Dielectric Fittings:

1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
2. Dielectric Unions:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) A.Y. McDonald Mfg. Co.
    - 2) Capitol Manufacturing Company.
    - 3) GF Piping Systems: Georg Fischer LLC.
    - 4) HART Industrial Unions, LLC.
    - 5) Jomar Valve.
    - 6) Matco-Norca.
    - 7) WATTS; A Watts Water Technologies Company.
    - 8) Wilkins.
    - 9) Zurn Industries, LLC.
  - b. Description:
    - 1) Standard: ASSE 1079.
    - 2) Pressure Rating: 150 psig.
    - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
3. Dielectric Flanges:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Capitol Manufacturing Company.
    - 2) GF Piping Systems: Georg Fischer LLC.
    - 3) Matco-Norca.
    - 4) WATTS; A Watts Water Technologies Company.
    - 5) Zurn Industries, LLC.
  - b. Description:
    - 1) Standard: ASSE 1079.
    - 2) Factory-fabricated, bolted, companion-flange assembly.



- 3) Pressure Rating: 150 psig.
  - 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
4. Dielectric-Flange Insulating Kits:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Advance Products & Systems, LLC.
    - 2) CALPICO, Inc.
    - 3) GF Piping Systems: Georg Fischer LLC.
    - 4) GPT; a division of EnPRO Industries.
  - b. Description:
    - 1) Nonconducting materials for field assembly of companion flanges.
    - 2) Pressure Rating: 150 psig.
    - 3) Gasket: Neoprene or phenolic.
    - 4) Bolt Sleeves: Phenolic or polyethylene.
    - 5) Washers: Phenolic with steel backing washers.
5. Dielectric Nipples:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Anvil; an ASC Engineered Solution.
    - 2) Elster Perfection; Honeywell.
    - 3) Matco-Norca.
    - 4) Precision Plumbing Products.
    - 5) Victaulic Company.
  - b. Description:
    - 1) Standard: IAPMO PS 66.
    - 2) Electroplated steel nipple.
    - 3) Pressure Rating: 300 psig at 225 deg F.
    - 4) End Connections: Male threaded or grooved.

- 5) Lining: Inert and noncorrosive, propylene.

## 2.6 ENCASEMENT FOR UNDERGROUND METAL PIPING

- A. Standard: ASTM A674 or AWWA C105/A 21.5.
- B. Material: Linear low-density polyethylene film of 0.008-inch or high-density, cross-laminated polyethylene film of 0.004-inch minimum thickness.
- C. Form: Sheet or tube.
- D. Color: Black or natural.

## PART 3 - EXECUTION

### 3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

### 3.2 INSTALLATION OF PIPING

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
  - 1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
  - 2. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.

- I. Install piping to allow application of insulation.
- J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
  - 1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
  - 2. Use long-turn, double Y-branch, and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
    - a. Straight tees, elbows, and crosses may be used on vent lines.
  - 3. Do not change direction of flow more than 90 degrees.
  - 4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
    - a. Reducing size of waste piping in direction of flow is prohibited.
- K. Lay buried building waste piping beginning at low point of each system.
  - 1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
  - 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
  - 3. Maintain swab in piping and pull past each joint as completed.
- L. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
  - 1. Building Sanitary Waste: Two percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
  - 2. Horizontal Sanitary Waste Piping: Two percent downward in direction of flow.
  - 3. Vent Piping: One percent down toward vertical fixture vent or toward vent stack.
- M. Install aboveground copper tubing in accordance with CDA's "Copper Tube Handbook."
- N. Install aboveground PVC piping in accordance with ASTM D2665.
- O. Install underground PVC piping in accordance with ASTM D2321.
- P. Install force mains at elevations indicated.
- Q. Plumbing Specialties:

1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
  - a. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping.
  - b. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
2. Install drains in sanitary waste gravity-flow piping.
  - a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."
- R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- S. Install sleeves for piping penetrations of walls, ceilings, and floors.
  1. Comply with requirements for sleeves specified in Section 220500 "Common Work Results for Plumbing."
- T. Install sleeve seals for piping penetrations of concrete walls and slabs.
  1. Comply with requirements for sleeve seals specified in Section 220500 "Common Work Results for Plumbing."
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors.
  1. Comply with requirements for escutcheons specified in Section 220500 "Common Work Results for Plumbing."

### 3.3 JOINT CONSTRUCTION

- A. Grooved Joints: Cut groove ends of pipe in accordance with AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
- B. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.
- C. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:
  1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
  2. PVC Piping: Join in accordance with ASTM D2855 and ASTM D2665 appendixes.

D. Joint Restraints and Sway Bracing:

1. Provide joint restraints and sway bracing for storm drainage piping joints to comply with the following conditions:
  - a. Provide axial restraint for pipe and fittings 5 inches and larger, upstream and downstream of all changes in direction, branches, and changes in diameter greater than two pipe sizes.
  - b. Provide rigid sway bracing for pipe and fittings 4 inches and larger, upstream and downstream of all changes in direction 45 degrees and greater.
  - c. Provide rigid sway bracing for pipe and fittings 5 inches and larger, upstream and downstream of all changes in direction and branch openings.

3.4 INSTALLATION OF SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in ODs.
2. In Waste Drainage Piping: Shielded, nonpressure transition couplings.
3. In Aboveground Force Main Piping: Fitting-type transition couplings.
4. In Underground Force Main Piping:
  - a. NPS 1-1/2 (DN 40) and Smaller: Fitting-type transition couplings.
  - b. NPS 2 (DN 50) and Larger: Pressure transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric nipples.
3. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flanges.
4. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment".

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless steel pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42 clamps.
6. Install individual, straight, horizontal piping runs:
  - a. 100 Ft. (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.

- b. Longer Than 100 Ft. (30 m): MSS Type 43, adjustable roller hangers.
  - c. Longer Than 100 Ft. (30 m) if Indicated: MSS Type 49, spring cushion rolls.
- 7. Multiple, Straight, Horizontal Piping Runs 100 Ft. (30 m) or Longer: MSS Type 44 pipe rolls. Support pipe rolls on trapeze.
- 8. Base of Vertical Piping: MSS Type 52 spring hangers.
- C. Install hangers for cast-iron soil piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Install hangers for PVC piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- E. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- F. Support vertical runs of PVC piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

### 3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect waste and vent piping to the following:
  - 1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
  - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
  - 3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
  - 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
  - 5. Comply with requirements for cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
  - 6. Equipment: Connect waste piping as indicated.
    - a. Provide shutoff valve if indicated and union for each connection.

- b. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Connect force-main piping to the following:
  - 1. Sanitary Sewer: To exterior force main.
  - 2. Sewage Pump: To sewage pump discharge.
- E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- F. Make connections in accordance with the following unless otherwise indicated:
  - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

### 3.7 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping.
- B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

### 3.8 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
  - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
  - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary waste and vent piping in accordance with procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
  - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.

- a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
    - a. Expose work that was covered or concealed before it was tested.
  3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
    - a. Close openings in piping system and fill with water to point of overflow, but not less than 10 ft. head of water.
    - b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
    - c. Inspect joints for leaks.
  4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.
    - a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg.
    - b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
    - c. Air pressure must remain constant without introducing additional air throughout period of inspection.
    - d. Inspect plumbing fixture connections for gas and water leaks.
  5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  6. Prepare reports for tests and required corrective action.
- E. Test force-main piping in accordance with procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
  1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved.
    - a. Expose work that was covered or concealed before it was tested.
  2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials.
    - a. Isolate test source and allow to stand for four hours.
    - b. Leaks and loss in test pressure constitute defects that must be repaired.
  3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  4. Prepare reports for tests and required corrective action.



### 3.9 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Exposed Plastic Piping: Protect PVC plumbing vents exposed to sunlight with two coats of water-based latex paint.
- E. Repair damage to adjacent materials caused by waste and vent piping installation.

### 3.10 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping are to be the following:
  - 1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- C. Aboveground, vent piping is to be the following:
  - 1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
    - a. Option for Vent Piping, NPS 1-1/2 to NPS 3 (DN 65 and DN 90): Hard copper tube, Type DWV; copper pressure fittings; and soldered joints.
- D. Underground, soil, waste, and vent piping are to be the following:
  - 1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

END OF SECTION 221316

## SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Cleanouts.
  - 2. Miscellaneous sanitary drainage piping specialties.
- B. Related Requirements:
  - 1. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashing assemblies.
  - 2. Section 077200 "Roof Accessories" for preformed flashings.
  - 3. Section 078413 "Penetration Firestopping" for through-penetration firestop assemblies.
  - 4. Section 221423 "Storm Drainage Piping Specialties" for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.

#### 1.3 DEFINITIONS

- A. ABS: Acrylonitrile butadiene styrene.
- B. PVC: Polyvinyl chloride.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
  - 1. Show fabrication and installation details for frost-resistant vent terminals.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTIONS

- A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic sanitary waste piping specialty components.

2.2 CLEANOUTS

- A. Cast-Iron Exposed Cleanouts:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Jay R. Smith Mfg Co; a division of Morris Group International.
    - b. Josam Company.
    - c. MIFAB, Inc.
    - d. Tyler Pipe; a subsidiary of McWane Inc.
    - e. WATTS; A Watts Water Technologies Company.
    - f. Zurn Industries, LLC.
  - 2. Standard: ASME A112.36.2M.
  - 3. Size: Same as connected drainage piping
  - 4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
  - 5. Closure: Countersunk, brass plug.

6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
- B. Cast-Iron Exposed Floor Cleanouts: See schedule on drawings.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Jay R. Smith Mfg Co; a division of Morris Group International.
    - b. MIFAB, Inc.
    - c. WATTS; A Watts Water Technologies Company.
    - d. Zurn Industries, LLC.
  2. Standard: ASME A112.36.2M for heavy-duty, adjustable housing cleanout.
  3. Size: Same as connected branch.
  4. Type: Heavy-duty, adjustable housing.
  5. Body or Ferrule: Cast iron.
  6. Clamping Device: Required.
  7. Outlet Connection: Spigot.
  8. Closure: Brass plug with tapered threads.
  9. Adjustable Housing Material: Cast iron with threads.
  10. Frame and Cover Material and Finish: As per schedule.
  11. Frame and Cover Shape: Round.
  12. Top-Loading Classification: Heavy Duty.
  13. Riser: ASTM A74, Service Class, cast-iron drainage pipe fitting and riser to cleanout.
- C. Cast-Iron Wall Cleanouts: See schedule on drawings.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Jay R. Smith Mfg Co; a division of Morris Group International.
    - b. Josam Company.
    - c. MIFAB, Inc.
    - d. WATTS; A Watts Water Technologies Company.
    - e. Zurn Industries, LLC.

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure Plug:
  - a. Brass.
  - b. Countersunk head.
  - c. Drilled and threaded for cover attachment screw.
  - d. Size: Same as or not more than one size smaller than cleanout size.
6. Wall Access, Cover Plate: Round, flat, chrome-plated brass or stainless steel cover plate with screw.
7. Wall Access, Frame and Cover: Round, nickel-bronze, copper-alloy, or stainless steel wall-installation frame and cover.

## 2.3 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

### A. Floor-Drain, Inline Trap Seal:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Green Drain, Inc.
  - b. Jay R. Smith Mfg Co; a division of Morris Group International.
  - c. Josam Company.
  - d. MIFAB, Inc.
  - e. RectorSeal Plumbing; A CSW Industrials Company.
2. Description: Inline floor drain trap seal, forming a physical barrier to slow trap evaporation while not impeding flow from drain.
3. Material: Polymer.
4. Standard: Tested and certified in accordance with ASSE 1072.
5. Listing: ICC-ES listed.
6. Size: Same as floor drain outlet or strainer throat.

### B. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.

4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

C. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

D. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

E. Vent Caps:

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

F. Frost-Resistant Vent Terminals:

1. Description: Manufactured or shop-fabricated assembly constructed of copper, lead-coated copper, or galvanized steel.
2. Design: To provide 1-inch enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.

G. Expansion Joints:

1. Standard: ASME A112.6.4.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install backwater valves in building drain piping.

1. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
  1. Size same as drainage piping up to NPS 4. Use NPS 4 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 for piping NPS 4 and smaller and 100 feet for larger piping.
  4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Assemble open drain fittings and install with top of hub 1 inch above floor.
- F. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- G. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
  1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
  2. Size: Same as floor drain inlet.
- H. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- I. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.
- J. Install vent caps on each vent pipe passing through roof.
- K. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- L. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

- M. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- N. Install wood-blocking reinforcement for wall-mounting-type specialties.
- O. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

### 3.2 PIPING CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment, to allow service and maintenance.

### 3.3 LABELING AND IDENTIFYING

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.
  - 1. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

### 3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319



## SECTION 221319.13 - SANITARY DRAINS

### 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. Floor drains.

#### 1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene styrene.
- B. FRP: Fiberglass-reinforced plastic.
- C. HDPE: High-density polyethylene.
- D. PE: Polyethylene.
- E. PP: Polypropylene.
- F. PVC: Polyvinyl chloride.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

## PART 2 - PRODUCTS

### 2.1 DRAIN ASSEMBLIES

- A. Sanitary drains shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic sanitary piping specialty components.

### 2.2 FLOOR DRAINS

- A. Cast-Iron Floor Drains: See schedule on Drawings.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Jay R. Smith Mfg Co; a division of Morris Group International.
    - b. MIFAB, Inc.
    - c. WATTS; A Watts Water Technologies Company.
    - d. Zurn Industries, LLC.
  - 2. Standard: ASME A112.6.3.
  - 3. Pattern: Floor drain.
  - 4. Body Material: Gray iron.
  - 5. Outlet: Bottom.
  - 6. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant enamel.
  - 7. Trap Material: Cast iron.
  - 8. Trap Pattern: Deep-seal P-trap.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. 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.
  - 3. Set with grates depressed according to the following drainage area radii:
    - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
    - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
    - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
  - 4. Install floor-drain flashing collar or flange, so no leakage occurs between drain and adjoining flooring.
    - a. Maintain integrity of waterproof membranes where penetrated.
  - 5. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

### 3.2 CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Comply with requirements in Section 221319 "Sanitary Waste Piping Specialties" for backwater valves, air admittance devices and miscellaneous sanitary drainage piping specialties.
- C. Install piping adjacent to equipment to allow service and maintenance.
- D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 LABELING AND IDENTIFYING

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319.13

## **SECTION 22 14 00 - STORM DRAINAGE**

### **PART 1 - GENERAL**

#### **1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions and Special Conditions, apply to this Section.
- B. "Standard Specifications" shall mean the State of New York Department of Transportation Standard Specifications, May 1, 2024, its latest edition and any supplemental specifications.

#### **1.02 SECTION INCLUDES**

- A. This Section includes the installation of storm drainage and the abandonment and removal of existing storm drainage as indicated on the Drawings.

#### **1.03 RELATED SECTIONS**

- A. Section 31 23 16.13 – Trenching

#### **1.04 SUBMITTALS**

- A. Shop Drawings: Include plans, elevations, details, and attachments for the following:
  - 1. Precast concrete manholes, catch basins, field inlets and other structures, including frames, covers, and grates.
  - 2. Cast-in-place concrete manholes and other structures, including frames, covers, and grates.
- B. Submit pipe and bedding material certifications.

#### **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Do not store plastic structures, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle precast concrete manholes and other structures according to manufacturer's written rigging instructions.

#### **1.06 PROJECT CONDITIONS**

- A. Site Information: verify existing utility locations.
- B. Locate existing structures and piping to be closed and abandoned.

- C. Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
  - 1. Notify Engineer not less than two days in advance of proposed utility interruptions.
  - 2. Do not proceed with utility interruptions without Engineer's written permission.

## **PART 2 - PRODUCTS**

### **2.01 PIPING**

- A. Polyethylene Pipe: Corrugated smooth-lined high density polyethylene pipe, conforming to ASTM F405-05.
- B. Reinforced-Concrete Pipe and Fittings: Standard Specifications Section 706-02.

### **2.02 MANHOLES**

- A. Precast Concrete Manholes:
  - 1. Precast Units shall conform to Standard Specifications, 706-04 Precast Concrete Drainage Units, of depth indicated.
- B. Manhole Frames and Covers:
  - 1. Frames and Grates shall conform to Standard Specifications, Section 655 Frames, Grates and Covers.
- C. Manhole Steps:
  - 1. Steps shall conform to Standard Specifications Section 725-02, Steps for Manholes.

### **2.03 CATCH BASINS**

- A. Precast Concrete Catch Basins:
  - 1. Precast Units shall conform to Standard Specifications, Section 706-04.
- B. Catch Basin Frames and Grates:
  - 1. Frames and Grates shall conform to Standard Specifications, Section 655.

### **2.04 CONCRETE FOR CAST-IN-PLACE STRUCTURES**

- A. General: Use Class A concrete conforming to Standard Specifications 501 and construct in accordance with the requirements of Section 555, Structural Concrete.

## 2.05 SPRAY PAD DRAIN PEDESTRIAN FRAME & GRATE

- A. Frame and Grate shall be Campbell Foundry Company, Pattern Number 4129 0138; Phone 973-483-5480, Fax 973-483-1843; or approved equal.

## PART 3 - EXECUTION

### 3.01 EXCAVATING AND BACKFILLING

- A. Excavation and backfill shall conform to Section 31 23 33 – Trenching.

### 3.02 INSTALLATION, GENERAL

- A. Drawing plans and details indicate general location and arrangement of underground storm and sewer piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert.
- C. Place bell ends of piping facing upstream.
- D. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
- E. Maintain swab or drag in line, and pull past each joint as it is completed.
- F. Use manholes for changes in direction, unless fittings are indicated.
- G. Use fittings for branch connections, unless direct tap into existing sewer is indicated.
- H. Use proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected.
- I. Install gravity-flow piping of sizes and in locations indicated. Terminate piping as indicated.
  - 1. Install piping pitched down in direction of flow, at minimum slope of 1/2 of 1 percent (0.5%), unless otherwise indicated.
  - 2. Install piping with 18-inch minimum cover unless otherwise indicated.
- J. Join piping made of different materials or dimensions with couplings made for this application.
- K. Use couplings that are compatible with and that fit both systems' materials and dimensions.

3.03 CATCH-BASIN INSTALLATION

- A. Construct catch basins and spray pad drain to sizes and shapes indicated.
- B. Set frames and grates to elevations indicated.

3.04 CLOSING ABANDONED STORM DRAINAGE PIPING/PIPE OPENINGS

- A. Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:
  - 1. Close open ends of piping with at least 8-inch thick, brick masonry bulkheads.
  - 2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

3.05 FIELD QUALITY CONTROL

- A. Clear interior of piping and structures of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed.
  - 1. In large, accessible piping, brushes and brooms may be used for cleaning.
  - 2. Place plug in end of incomplete piping at end of day and when work stops.
  - 3. Flush piping between manholes and other structures to remove collected debris, if required by authorities having jurisdiction.
- B. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

3.06 CORING HOLES IN PIPES

- A. Align crowns of pipes for coring.
- B. Cast concrete collar and allow it to cure prior to coring the hole.
- C. Use equipment specifically designed for coring into pipes.
- D. Fully mortar joint between pipes.

**END OF SECTION 22 14 00**





## SECTION 221414 - STORM DRAINAGE PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Hub-and-spigot, cast-iron soil pipe and fittings.
2. Hubless, cast-iron soil pipe and fittings.
3. PVC pipe and fittings.
4. Specialty pipe fittings.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For controlled-flow roof drainage system. Include calculations, plans, sections, elevations, and details.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans and elevations, or Building Information Model (BIM) drawn to scale, showing items described in this Section and coordinated with all building trades.
- B. Seismic Qualification Certificates: For storm drainage piping, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Detailed description of piping anchorage devices on which the certificate is based and their installation requirements.
- C. Field Quality-Control Reports: Inspection reports signed by authorities having jurisdiction.

#### 1.4 QUALITY ASSURANCE

- A. Provide materials bearing label, stamp, or other markings of specified testing agency.

#### 1.5 WARRANTY

- A. Listed manufacturers to provide labeling and warranty of their respective products

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Components and installation are to be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Storm Drainage Piping: 10-foot head of water.

## 2.2 PIPING MATERIALS

- A. Piping materials to bear label, stamp, or other markings of specified testing agency.
- B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

## 2.3 COPPER TUBE AND FITTINGS

### A. Copper Tube:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Cambridge-Lee Industries, LLC.
  - b. Cerro Flow Products, LLC.
  - c. Wieland Copper Products, LLC.
2. Copper Type DWV Tube: ASTM B306, drainage tube, drawn temper.
3. Copper Tube, Drawn Temper: ASTM B88, Type L and Type M.
4. Copper Tube, Annealed Temper: ASTM B88, Type L.

### B. Copper Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. NIBCO INC.
2. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

3. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
  - a. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
  - b. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder: ASTM B32, lead free with ASTM B813, water-flushable flux.

## 2.4 PVC PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  2. Charlotte Pipe and Foundry Company.
  3. GF Piping Systems.
  4. JM Eagle.
  5. National Pipe and Plastic, Inc.
  6. North America Pipe Corporation.
  7. Rocky Mountain Colby Pipe Company.
  8. Silver-line Plastics.
- B. Comply with NSF 14 for plastic piping components. Include "NSF-dwv" marking for plastic drain, waste, and vent piping and "NSF-sewer" marking for plastic sewer piping.
- C. Solid-Wall PVC Pipe: ASTM D2665 drain, waste, and vent.
- D. PVC Socket Fittings: ASTM D2665, made in accordance with ASTM D3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- E. Adhesive Primer: ASTM F656.
- F. Solvent Cement: ASTM D2564.

## 2.5 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
  1. General Requirements: Fitting or device for joining piping with small differences in ODs or of different materials. Include end connections of same size as and compatible with pipes to be joined.

2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
3. Unshielded, Nonpressure Transition Couplings:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Dallas Specialty & Mfg. Co.
    - 2) Fernco Inc.
    - 3) Mission Rubber Company, LLC; a division of MCP Industries.
    - 4) Plastic Oddities.
  - b. Standard: ASTM C1173.
  - c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
  - d. End Connections: Same size as and compatible with pipes to be joined.
  - e. Sleeve Materials:
    - 1) For Cast-Iron Soil Pipes: ASTM C564, rubber.
    - 2) For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926 PVC.
    - 3) For Dissimilar Pipes: ASTM D5926 PVC or other material compatible with pipe materials being joined.
4. Shielded, Nonpressure Transition Couplings:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Cascade Waterworks Mfg. Co.
    - 2) Mission Rubber Company, LLC; a division of MCP Industries.
  - b. Standard: ASTM C1460.
  - c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
  - d. End Connections: Same size as and compatible with pipes to be joined.
5. Pressure Transition Couplings:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Apollo Valves; a part of Aalberts Integrated Piping Systems.
    - 2) Cascade Waterworks Mfg. Co.
    - 3) EBAA Iron Sales, Inc.
    - 4) Ford Meter Box Company, Inc. (The).
    - 5) JCM Industries, Inc.
    - 6) Romac Industries, Inc.
  - b. Standard: AWWA C219.

- c. Description: Metal sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
- d. Center-Sleeve Material: Stainless steel.
- e. Gasket Material: Natural or synthetic rubber.
- f. Metal Component Finish: Corrosion-resistant coating or material.

B. Dielectric Fittings:

- 1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- 2. Dielectric Unions:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) A.Y. McDonald Mfg. Co.
    - 2) Capitol Manufacturing Company.
    - 3) GF Piping Systems: Georg Fischer LLC.
    - 4) HART Industrial Unions, LLC.
    - 5) Jomar Valve.
    - 6) Matco-Norca.
    - 7) WATTS; A Watts Water Technologies Company.
    - 8) Wilkins.
    - 9) Zurn Industries, LLC.
  - b. Description:
    - 1) Standard: ASSE 1079.
    - 2) Pressure Rating: 150 psig.
    - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
- 3. Dielectric Flanges:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Capitol Manufacturing Company.
    - 2) GF Piping Systems: Georg Fischer LLC.
    - 3) Matco-Norca.
    - 4) WATTS; A Watts Water Technologies Company.
    - 5) Zurn Industries, LLC.
  - b. Description:
    - 1) Standard: ASSE 1079.
    - 2) Factory-fabricated, bolted, companion-flange assembly.
    - 3) Pressure Rating: 150 psig.
    - 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

4. Dielectric-Flange Insulating Kits:

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) Advance Products & Systems, LLC.
- 2) CALPICO, Inc.
- 3) GF Piping Systems: Georg Fischer LLC.
- 4) GPT; a division of EnPRO Industries.

- b. Description:

- 1) Nonconducting materials for field assembly of companion flanges.
- 2) Pressure Rating: 150 psig.
- 3) Gasket: Neoprene or phenolic.
- 4) Bolt Sleeves: Phenolic or polyethylene.
- 5) Washers: Phenolic with steel backing washers.

5. Dielectric Nipples:

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) Anvil; an ASC Engineered Solution.
- 2) Elster Perfection; Honeywell.
- 3) Matco-Norca.
- 4) Precision Plumbing Products.
- 5) Victaulic Company.

- b. Description:

- 1) Standard: IAPMO PS 66.
- 2) Electroplated steel nipple.
- 3) Pressure Rating: 300 psig at 225 deg F.
- 4) End Connections: Male threaded or grooved.
- 5) Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 INSTALLATION OF PIPING

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.



- B. Install piping as indicated unless deviations from layout are approved on coordination drawings.
- C. Install piping in concealed locations.
  - 1. Piping installed in equipment rooms, service areas, and where indicated may be exposed.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.

- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Make changes in direction for piping using appropriate branches, bends, and long-sweep bends.
  - 1. Do not change direction of flow more than 90 degrees.
  - 2. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
    - a. Reducing size of drainage piping in direction of flow is prohibited.
- L. Lay buried building piping beginning at low point of each system.
  - 1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
  - 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
  - 3. Maintain swab in piping and pull past each joint as completed.
- M. Install piping at the following minimum slopes unless otherwise indicated.
  - 1. Building Storm Drain: 1/4 inch per foot downward in direction of flow for piping NPS 3 and smaller; 1/8 inch per foot downward in direction of flow for piping NPS 4 and larger.
  - 2. Horizontal Storm Drainage Piping: 1/8 inch per foot downward in direction of flow.
- N. Install underground PVC piping in accordance with ASTM D2321.
- O. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- P. Install sleeves for piping penetrations of walls, ceilings, and floors.
  - 1. Comply with requirements for sleeves specified in Section 220500 "Common Work Results for Plumbing."
- Q. Install sleeve seals for piping penetrations of concrete walls and slabs.
  - 1. Comply with requirements for sleeve seals specified in Section 220500 "Common Work Results for Plumbing."
- R. Install escutcheons for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for escutcheons specified in Section 220500 "Common Work Results for Plumbing."

### 3.3 JOINT CONSTRUCTION

- A. Grooved Joints: Cut groove ends of pipe in accordance with AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fittings. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
- B. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.
- C. Joint Restraints and Sway Bracing:
  1. Provide joint restraints and sway bracing for storm drainage piping joints to comply with the following conditions:
    - a. Provide axial restraint for pipe and fittings 5 inches and larger, upstream and downstream of all changes in direction, branches, and changes in diameter greater than two pipe sizes.
    - b. Provide rigid sway bracing for pipe and fittings 4 inches and larger, upstream and downstream of all changes in direction 45 degrees and greater.
    - c. Provide rigid sway bracing for pipe and fittings 5 inches and larger, upstream and downstream of all changes in direction and branch openings.

### 3.4 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for hangers, supports, and anchor devices specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
  1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
  2. Install stainless steel pipe hangers for horizontal piping in corrosive environments.
  3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
  4. Install stainless steel pipe support clamps for vertical piping in corrosive environments.
  5. Vertical Piping: MSS Type 8 or Type 42, clamps.
  6. Install individual, straight, horizontal piping runs:
    - a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet (30 m) if Indicated: MSS Type 49, spring cushion rolls.

7. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  8. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install hangers for cast-iron soil piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- C. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- D. Support vertical cast-iron and copper tubing and piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent, but as a minimum at base and at each floor.

### 3.5 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect storm drainage piping to roof drains and storm drainage specialties.
1. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
  2. Comply with requirements for cleanouts and drains specified in Section 221423 "Storm Drainage Piping Specialties."
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make connections in accordance with the following unless otherwise indicated:
1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

### 3.6 IDENTIFICATION

- A. Identify exposed storm drainage piping.

- B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

### 3.7 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
  - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
  - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test storm drainage piping in accordance with procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
  - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
    - a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  - 2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved.
    - a. Expose work that was covered or concealed before it was tested.
  - 3. Test Procedure:
    - a. Test storm drainage piping, except outside leaders, on completion of roughing-in.
    - b. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
    - c. From 15 minutes before inspection starts until completion of inspection, water level must not drop.
    - d. Inspect joints for leaks.
  - 4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  - 5. Prepare reports for tests and required corrective action.

3.8 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.

3.9 PROTECTION

- A. Protect piping and drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- B. Place plugs in ends of uncompleted piping at end of day and when work stops.
- C. Repair damage to adjacent materials caused by storm drainage piping installation.

3.10 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground storm drainage piping is to be the following:
  - 1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- C. Underground storm drainage piping shall be the following:
  - 1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  - 2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- D. Aboveground storm drainage force mains NPS 1-1/2 and NPS 2 is to be the following:
  - 1. Hard copper tube, Type L copper pressure fittings, and soldered joints.

END OF SECTION 221414

## SECTION 221423 - STORM DRAINAGE PIPING SPECIALTIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. General-purpose roof drains.
2. Miscellaneous storm drainage piping specialties.
3. Cleanouts.

##### B. Related Requirements:

1. Section 076200 "Sheet Metal Flashing and Trim" for penetrations of roofs.
2. Section 078413 "Penetration Firestopping" for firestopping roof penetrations.

#### 1.2 ACTION SUBMITTALS

##### A. Product Data:

1. General-purpose roof drains.
2. Miscellaneous storm drainage piping specialties.
3. Cleanouts.

#### 1.3 QUALITY ASSURANCE

- ##### A.
- Provide drainage piping specialties are to bear label, stamp, or other markings of specified testing agency.

### PART 2 - PRODUCTS

#### 2.1 GENERAL-PURPOSE ROOF DRAINS

##### A. Cast-Iron Roof Drains:

1. Cast-Iron, Large-Sump, General-Purpose Roof Drains: See schedule on drawings.
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Jay R. Smith Mfg Co; a division of Morris Group International.
    - 2) MIFAB, Inc.
    - 3) WATTS; A Watts Water Technologies Company.
    - 4) Zurn Industries, LLC.



- b. Standard: ASME A112.6.4.
- c. Body Material: Cast iron.

## 2.2 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

### A. Metal Downspout Nozzles: See schedule on drawings.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Jay R. Smith Mfg Co; a division of Morris Group International.
  - b. WATTS; A Watts Water Technologies Company.
  - c. Wade; a subsidiary of McWane Inc.
  - d. Zurn Industries, LLC.
2. Description: Nozzle with wall flange and mounting holes to cover rough opening and serve as anchor.
3. Size: Same as connected downspout.
4. Material: Cast bronze or nickel bronze nozzle and flange.
5. Piping Connection Type: No-hub.

## 2.3 CLEANOUTS

### A. Cast-Iron Exposed Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Jay R. Smith Mfg Co; a division of Morris Group International.
  - b. Josam Company.
  - c. MIFAB, Inc.
  - d. Tyler Pipe; a subsidiary of McWane Inc.
  - e. WATTS; A Watts Water Technologies Company.
  - f. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

### B. Cast-Iron Exposed Floor Cleanouts: See schedule on drawings.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Jay R. Smith Mfg Co; a division of Morris Group International.
  - b. MIFAB, Inc.

- c. WATTS; A Watts Water Technologies Company.
  - d. Zurn Industries, LLC.
- 2. Standard: ASME A112.36.2M for heavy-duty, adjustable housing cleanout.
  - 3. Size: Same as connected branch.
  - 4. Type: Heavy-duty, adjustable housing.
  - 5. Body or Ferrule: Cast iron.
  - 6. Clamping Device: Required.
  - 7. Outlet Connection: Spigot.
  - 8. Closure: Brass plug with tapered threads.
  - 9. Adjustable Housing Material: Cast iron with threads.
  - 10. Frame and Cover Material and Finish: As per schedule.
  - 11. Frame and Cover Shape: Round.
  - 12. Top-Loading Classification: Heavy Duty.
  - 13. Riser: ASTM A74, Service Class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts: See schedule on drawings.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Jay R. Smith Mfg Co; a division of Morris Group International.
  - b. Josam Company.
  - c. MIFAB, Inc.
  - d. WATTS; A Watts Water Technologies Company.
  - e. Zurn Industries, LLC.
- 2. Standard: ASME A112.36.2M. Include wall access.
- 3. Size: Same as connected drainage piping.
- 4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
- 5. Closure Plug:
  - a. Brass.
  - b. Countersunk head.
  - c. Drilled and threaded for cover attachment screw.
  - d. Size: Same as or not more than one size smaller than cleanout size.
- 6. Wall Access, Cover Plate: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
- 7. Wall Access, Frame and Cover: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install roof drains in accordance with roof membrane manufacturer's written installation instructions at low points of roof areas.
  - 1. Install flashing collar or flange of roof drain to maintain integrity of waterproof membranes where penetrated.
  - 2. Install expansion joints, if indicated, in roof drain outlets.
  - 3. Position roof drains for easy access and maintenance.
- B. Install downspout nozzles at exposed bottom of conductors where they spill onto grade.
- C. Install cleanouts in aboveground piping and building drain piping in accordance with the following instructions unless otherwise indicated:
  - 1. Use cleanouts the same size as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
  - 2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
  - 3. Locate cleanouts at minimum intervals of 50 ft. for piping NPS 4 and smaller and 100 ft. for larger piping.
  - 4. Locate cleanouts at base of each vertical storm piping conductor.
- 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 wall cleanouts in vertical conductors. Install access door in wall if indicated.
- G. Install through-penetration firestop assemblies for penetrations of fire- and smoke-rated assemblies.
  - 1. Comply with requirements in Section 078413 "Penetration Firestopping."

### 3.2 CONNECTIONS

- A. Comply with requirements for piping specified in Section 221414 "Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 INSTALLATION OF FLASHING

- A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.

3.4 CLEANING

- A. Clean piping specialties during installation and remove dirt and debris as work progresses.

3.5 PROTECTION

- A. Protect piping specialties during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic and construction work.
- B. Place plugs in ends of uncompleted piping at end of each day and when work stops.

END OF SECTION 221423

## SECTION 221429 - SUMP PUMPS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Sump pumps - submersible.

B. Related Requirements:

#### 1.2 ACTION SUBMITTALS

A. Product Data:

1. Sump pumps - submersible.

B. Product Data Submittals: For each product.

1. Construction details, material descriptions, dimensions of individual components and profiles.
2. Rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

C. Shop Drawings:

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For pumps and controls.
  - 1. Indicate actual installed items by marking submittals with an arrow or box.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.
- C. Comply with manufacturer's written instructions for handling.

1.5 WARRANTY

- A. Manufacturer Warranty: Manufacturer and Installer agree to repair or replace sump pumps that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 1 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each type of sump pump from single source from single manufacturer.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.
- B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

## 2.3 SUMP PUMPS - SUBMERSIBLE

- A. Sump Pumps - Submersible, Fixed Position, Double Seal: See schedule on drawings.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. EBARA Pumps Americas Corp.
    - b. GRUNDFOS CBS Inc.
    - c. Industrial Flow Solutions.
    - d. Xylem.
  - 2. Description: Factory-assembled and -tested sump-pump unit.
  - 3. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sump pump as defined in HI 14.1-14.2 and HI 14.3.
  - 4. Pump Casing: Cast iron, with strainer inlet; legs that elevate pump to permit flow into impeller; and vertical discharge for piping connection.
  - 5. Impeller: Statically and dynamically balanced, manufacturer's standard designed for clear wastewater handling, and keyed and secured to shaft.
  - 6. Pump and Motor Shaft: Stainless steel, with factory-sealed, grease-lubricated ball bearings.
  - 7. Seals: Mechanical.
  - 8. Moisture-Sensing Probe: Internal moisture sensor and moisture alarm.
  - 9. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.

- a. Motor Housing Fluid: Air.
- 10. Capacities and Characteristics: See schedule on drawings.
- 11. Controls, Rod-and-Float Type:
  - a. Enclosure: NEMA 250, Type 4X.
  - b. Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
  - c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
  - d. Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than 60 inches.
  - e. High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120 V ac, with transformer and contacts for remote alarm bell.
- 12. Control-Interface Features:
  - a. Remote Alarm Contacts: For remote alarm interface.
  - b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
    - 1) On-off status of pump.
    - 2) Alarm status.

## 2.4 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220500 "Common Work Results for Plumbing."
  - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- B. Motors for submersible pumps are to be hermetically sealed.



### PART 3 - EXECUTION

#### 3.1 EARTHWORK

- A. Excavation and filling are specified in Section 312000 "Earth Moving."

#### 3.2 EXAMINATION

- A. Examine roughing-in for plumbing piping to verify actual locations of storm drainage piping connections before sump-pump installation.

#### 3.3 INSTALLATION

- A. Pump Installation Standards: Comply with HI 14.4 for installation of sump pumps.
- B. Equipment Mounting:
  - 1. Comply with requirements for vibration isolation devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."
- C. Wiring Method: Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

#### 3.4 PIPING CONNECTIONS

- A. Comply with requirements for piping specified in Section 221414 "Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to equipment, allow space for service and maintenance.

#### 3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks in accordance with manufacturer's written instructions.

### 3.6 ADJUSTING

- A. Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust control set points.

### 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, inspect, and adjust components, assemblies, and equipment installations, including connections.
- C. Tests and inspections:
  1. Perform each visual and mechanical inspection.
  2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  5. Pumps and controls will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain pumps.

END OF SECTION 221429

## SECTION 223300 - ELECTRIC, DOMESTIC-WATER HEATERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Commercial, electric, storage, domestic-water heaters.
2. Domestic-water heater accessories.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Include diagrams for power, signal, and control wiring.

#### 1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Equipment room drawing or BIM model, drawn to scale, on which the items described in this Section are shown and coordinated with all building trades.

B. Product Certificates: For each type of commercial and tankless, electric, domestic-water heater.

- C. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.
- D. Source quality-control reports.
- E. Field quality-control reports.
- F. Sample Warranty: For special warranty.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For electric, domestic-water heaters to include emergency, operation, and maintenance manuals.

#### 1.5 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

#### 1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including storage tank and supports.
    - b. Faulty operation of controls.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
  - 2. Warranty Periods: From date of Substantial Completion.
    - a. Commercial, Electric, Storage, Domestic-Water Heaters:
      - 1) Storage Tank: Five years.
      - 2) Controls and Other Components: Five years.
    - b. Electric, Tankless, Domestic-Water Heaters: Five year(s).
    - c. Expansion Tanks: Three years.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.
- B. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.
- C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

### 2.2 COMMERCIAL, ELECTRIC, DOMESTIC-WATER HEATERS

- A. Commercial, Electric, Storage, Domestic-Water Heaters:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. A. O. Smith Corporation.
    - b. Bradford White Corporation.
    - c. Lochinvar, LLC.
    - d. Rheem Manufacturing Company.
    - e. State Industries.
  - 2. Source Limitations: Obtain domestic-water heaters from single source from single manufacturer.
  - 3. Standard: UL 1453.

4. Storage-Tank Construction: ASME-code, steel vertical arrangement.
  - a. Tappings: Factory fabricated of materials compatible with tank and piping connections. Attach tappings to tank before testing.
    - 1) NPS 2 (DN 50) and Smaller: Threaded ends in accordance with ASME B1.20.1.
    - 2) NPS 2-1/2 (DN 65) and Larger: Flanged ends in accordance with ASME B16.5 for steel and stainless steel flanges, and in accordance with ASME B16.24 for copper and copper-alloy flanges.
  - b. Pressure Rating: 150 psig.
  - c. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending lining material into tappings.
5. Factory-Installed, Storage-Tank Appurtenances:
  - a. Anode Rod: Replaceable magnesium.
  - b. Drain Valve: Corrosion-resistant metal with hose-end connection.
  - c. Insulation: Comply with ASHRAE/IES 90.1.
  - d. Jacket: Steel with enameled finish or high-impact composite material.
  - e. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
  - f. Temperature Control: Adjustable thermostat.
  - g. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
  - h. Relief Valves: ASME rated and stamped for combination temperature-and-pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select one relief valve with sensing element that extends into storage tank.

B. Capacity and Characteristics: See schedules on drawings.

## 2.3 DOMESTIC-WATER HEATER ACCESSORIES

### A. Domestic-Water Expansion Tanks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. A. O. Smith Corporation.
  - b. AMTROL, Inc.
  - c. Flexcon Industries.
  - d. Honeywell International Inc.
  - e. State Industries.
  - f. Taco Comfort Solutions.
2. Source Limitations: Obtain domestic-water expansion tanks from single source from single manufacturer.

3. Description: Steel pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
4. Construction:
  - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
  - b. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
  - c. Air-Charging Valve: Factory installed.
5. Capacity and Characteristics:
  - a. Working-Pressure Rating: 150 psig.
  - b. Capacity Acceptable: See schedule on drawings.
  - c. Air Precharge Pressure: System Pressure at Point of Connection.
- B. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads.
- C. Piping-Type Heat Traps: Field-fabricated piping arrangement in accordance with ASHRAE/IES 90.1.
- D. Heat-Trap Fittings: ASHRAE/IES 90.1.
- E. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valves with sensing element that extends into storage tank.

- F. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than working-pressure rating of domestic-water heater.
- G. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.
- H. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.
- I. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Include dimension that will support bottom of domestic-water heater a minimum of 18 inches above the floor.
- J. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

## 2.4 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, in accordance with ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.
- C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base. Comply with requirements for concrete bases specified in Section 033000 "Cast-in-Place Concrete."



1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
  2. Maintain manufacturer's recommended clearances.
  3. Arrange units so controls and devices that require servicing are accessible.
  4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
  5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  7. Install anchor bolts to elevations required for proper attachment to supported equipment.
  8. Anchor domestic-water heaters to substrate.
- B. Install electric, domestic-water heaters level and plumb, in accordance with layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523 "General-Duty Valves for Plumbing Piping."
- C. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend domestic-water heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- D. Install combination temperature-and-pressure relief valves in water piping for electric, domestic-water heaters without storage. Extend domestic-water heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- E. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."
- F. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 220500 "Common Work Results for Plumbing."
- G. Install thermometers on inlet and outlet piping of residential, solar, electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 220500 "Common Work Results for Plumbing."

- H. Assemble and install inlet and outlet piping manifold kits for multiple electric, domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each electric, domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each electric, domestic-water heater outlet. Comply with requirements for valves specified in Section 220523 "General-Duty Valves for Plumbing Piping" and comply with requirements for thermometers specified in Section 220500 "Common Work Results for Plumbing."
- I. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.
- J. Fill electric, domestic-water heaters with water.
- K. Charge domestic-water expansion tanks with air to required system pressure.
- L. Install dielectric fittings in all locations where piping of dissimilar metals is to be joined. The wetted surface of the dielectric fitting contacted by potable water to contain less than 0.25 percent of lead by weight.

### 3.2 PIPING CONNECTIONS

- A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

### 3.3 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

### 3.4 FIELD QUALITY CONTROL

- A. Testing Agency:
  - 1. Owner will engage a qualified testing agency to perform tests and inspections.
  - 2. Engage a qualified testing agency to perform tests and inspections.

- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections with the assistance of a factory-authorized service representative.
- D. Tests and Inspections:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.

### 3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial and tankless, electric, domestic-water heaters. Training to be a minimum of one hour(s).

END OF SECTION 223300

## SECTION 224200 - COMMERCIAL PLUMBING FIXTURES

### 1.1 SUMMARY

#### A. Section Includes:

1. Commercial lavatories.
2. Commercial showers.
3. Commercial sinks.
4. Commercial urinals.
5. Commercial water closets.
6. Flushometer valves.
7. Toilet seats.
8. Fixture carriers.

#### B. Related Requirements:

1. Section 224500 "Emergency Plumbing Fixtures" for emergency plumbing fixtures.

### 1.2 DEFINITIONS

- A. FRP: Fiberglass-reinforced plastic.
- B. PMMA: Polymethyl methacrylate; also known as "acrylic."
- C. Standard-Efficiency Flush Volume: 1.6 gal. per flush.
- D. High-Efficiency Flush Volume: 1.28 gal. or less per flush.
- E. WaterSense Fixture: Water closet and/or flushometer valve/tank certified by the EPA to meet the WaterSense performance criteria.

### 1.3 ACTION SUBMITTALS

A. Product Data:

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for plumbing fixtures.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Plans, elevations, sections, and mounting details.
2. Details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories and/or counter-mounted sinks.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. For lavatories and faucets.
  - a. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - 1) Servicing and adjustments of automatic faucets.
2. For shower valves to include in maintenance manuals
3. For sinks and faucets to include in operation and maintenance manuals.

- a. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

- 1) Servicing and adjustments of automatic faucets.
4. For flushometer valves and electronic sensors to include in operation and maintenance manuals.
5. For wash fountains and components to include in operation and maintenance manuals.

#### 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.
3. Shower Valve Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
4. Shower Valve Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.
5. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than six of each type.

#### PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

- A. Lavatory faucets, sink faucets, shower valves, and wash fountain spray heads and faucets intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
- 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 COMMERCIAL LAVATORIES

### A. Lavatories, Counter Mounted:

#### 1. Lavatory, Counter Mounted - Vitreous China, Self-Rimming, LAV-2:

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1) American Standard.
  - 2) Kohler Co.
  - 3) Sloan Valve Company.
  - 4) TOTO USA, INC.
- b. Fixture:
  - 1) Standard: ASME A112.19.2/CSA B45.1.
  - 2) Type: Under counter mounted with mounting brackets.
  - 3) Characteristics: See schedule on drawings.
- c. Faucet: LF-1.

### B. Lavatories, Wall Mounted:

#### 1. Lavatories, Wall Mounted - Vitreous China, Rectangular with Ledge Back LAV-1:

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1) American Standard.
  - 2) Kohler Co.
  - 3) Sloan Valve Company.
  - 4) TOTO USA, INC.
- b. Fixture:
  - 1) Standard: ASME A112.19.2/CSA B45.1.

- 2) Type: For wall hanging.
- 3) Characteristics: See schedule on drawings.
- 4) Faucet-Hole Punching: Coordinate with faucet.
- 5) Faucet-Hole Location: Top.
- 6) Mounting Material: Chair carrier.

- c. Faucet: LF-1.
- d. Support: Lavatory carrier, floor affixed with steel uprights, concealed arm.
- e. Lavatory Mounting Height: Standard, Accessible in accordance with ICC A117.1.

C. Lavatory Faucets, Automatically Operated, LF-1:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Standard.
  - b. Chicago Faucets; Geberit Group.
  - c. Kohler Co.
  - d. Sloan Valve Company.
  - e. Speakman Company.
  - f. T&S Brass and Bronze Works, Inc.
  - g. TOTO USA, INC.
  - h. Zurn Industries, LLC.
- 2. Standards: ASME A112.18.1/CSA B125.1 and UL 1951.
- 3. Operation Type: Battery powered electronic sensor operated, nonmixing.



4. 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.
5. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
6. Body Type: Single hole.
7. Body Material: Commercial, solid-brass, or die-cast housing with brazed copper and brass waterway.
8. Finish: Polished chrome plate.
9. Maximum Flow Rate: 0.5 gpm.
10. Mounting Type: Deck, concealed.
11. Spout: Rigid type.
12. Spout Outlet: Aerator.
13. Drain: Not part of faucet.

D. Lavatory Supply Fittings:

1. NSF Standard: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.
2. Standard: ASME A112.18.1/CSA B125.1.
3. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless steel wall flange.
4. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
5. Operation: Loose key.
6. Risers:
  - a. NPS 3/8.
  - b. ASME A112.18.6/CSA B125.6, braided or corrugated stainless steel, flexible hose riser.

E. Lavatory Waste Fittings:

1. Standard: ASME A112.18.2/CSA B125.2.
2. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.
3. Trap:
  - a. Size: NPS 1-1/2 by NPS 1-1/4.
  - b. Material:

- 1) Chrome-plated, two-piece, cast-brass trap and ground-joint swivel elbow with 0.032-inch-thick brass tube to wall; and chrome-plated, brass or steel wall flange.

## 2.3 COMMERCIAL SHOWERS

### A. Shower Valve Assemblies:

1. Shower Valve Assemblies - Single-Handle, Thermostatic Mixing Valve with Head - SH-1:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Lawler Manufacturing Company, Inc.
    - 2) POWERS; A Watts Water Technologies Company.
  - b. Source Limitations: Obtain shower heads and shower valves from single source from single manufacturer.
  - c. Description: Single-handle, accessible, thermostatic mixing valve with hot- and cold-water indicators; diverting valve; check stops; and hose with handheld shower head shower head.
  - d. Shower Valve:
    - 1) Standards:
      - a) ASME A112.18.1/CSA B125.1.
      - b) ASSE 1016/ASME A112.1016/CSA B125.16.
    - 2) Body Material: Solid brass.
    - 3) Finish: Polished chrome plate.
    - 4) Mounting: Concealed.
    - 5) Operation: Single-handle, push-pull or twist or rotate control.
    - 6) Antiscald Device: Integral with mixing valve.
    - 7) Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.
  - e. Supply Connections: NPS 1/2.
  - f. Shower Head:
    - 1) Standard: ASME A112.18.1/CSA B125.1.
    - 2) Type: Ball joint with arm and flange.
    - 3) EPA WaterSense: Required.
    - 4) Shower Head Maximum Flow Rate: 2.0 gpm.
    - 5) Shower Head Material: Metallic with chrome-plated finish.
    - 6) Spray Pattern: Adjustable.
    - 7) Integral Volume Control: Not required.
    - 8) Temperature Indicator: Integral with valve.

B. Shower Basins:

1. Shower Basins - Precast Terrazzo SH-1

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1) Acorn Engineering Company; a Division of Morris Group International
  - 2) Fiat Products.
  - 3) Florestone Products Co., Inc.
  - 4) Stern-Williams Products, LLC.
- b. Source Limitations: Obtain shower basins from single source from single manufacturer.
- c. Description: Precast-terrazzo base for built-up-type shower fixture.
- d. Standard: CSA B45.8/IAPMO Z403.
- e. Type: Accessible in accordance with ICC A117.1.
- f. Characteristics: See schedule on drawings.
- g. Outlet: Drain with NPS 2 outlet.

C. Grout:

- 1. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- 2. Characteristics: Nonshrink; recommended for interior and exterior applications.
- 3. Design Mix: 5000 psi, 28-day compressive strength.
- 4. Packaging: Premixed and factory packaged.

2.4 COMMERCIAL SINKS

A. Service Sinks, Floor Mounted:

1. Service Sinks, Floor Mounted - Terrazzo MSB-1:

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1) Acorn Engineering Company; a Division of Morris Group International.
  - 2) Fiat Products.
  - 3) Florestone Products Co., Inc.
  - 4) Stern-Williams Products, LLC.
- b. Source Limitations: Obtain sinks from single source from single manufacturer.
- c. Fixture:
  - 1) Material: Marble chips cast in portland cement to produce a compressive strength of not less than 3000 psi, seven days after casting.
  - 2) Characteristics: See schedule on drawings.
  - 3) Drain: Grid with NPS 3 outlet.
- d. Mounting: On floor and flush to wall.
- e. Faucet: MSB-1.

B. Kitchen/Utility Sinks:

1. Kitchen/Utility Sinks, Counter Mounted - Stainless Steel SK-1:

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1) Advance Tabco.
  - 2) Amerisink Inc.
  - 3) Eagle Group.
  - 4) Elkay.
  - 5) Just Manufacturing.
  - 6) Krowne.
- b. Source Limitations: Obtain sinks from single source from single manufacturer.
- c. Fixture:
  - 1) Standard: ASME A112.19.3/CSA B45.4.
  - 2) Type: Stainless steel, undermount, sound-deadened unit.
  - 3) Number of Compartments: One.
  - 4) Material: 18 gauge, Type 304 stainless steel.

- 5) Characteristics: See schedule on drawings.
  - 6) Compartment:
    - a) Drain: NPS 1-1/2 tailpiece with stopper.
    - b) Depth: Accessible in accordance with ICC A117.1.
  - d. Faucet(s): SK-1.
    - 1) Number Required: One.
    - 2) Mounting: On counter. Coordinate openings in counter.
  - e. Supply Fittings:
    - 1) Standard: ASME A112.18.1/CSA B125.1.
    - 2) Supplies: Chrome-plated brass compression stop with inlet connection matching water-supply piping type and size.
      - a) Operation: Loose key.
      - b) Risers: NPS 1/2, ASME A112.18.6/CSA B125.6, braided or corrugated stainless steel flexible hose.
  - f. Waste Fittings:
    - 1) Standard: ASME A112.18.2/CSA B125.2.
    - 2) Trap(s) Size: NPS 1-1/2.
    - 3) Trap(s) Material:
      - a) Chrome-plated, two-piece, cast-brass trap and ground-joint swivel elbow with 17-gauge brass tube to wall; and chrome-plated brass or steel wall flange.
  - g. Mounting: Under-counter, provide mounting brackets and seal to counter with sealant.
- C. Sink Faucets, Manually Operated:

1. Sink Faucets, Manually Operated SK-1: Single control, mixing.
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Chicago Faucets; Geberit Group.
    - 2) Elkay.
    - 3) Kohler Co.
    - 4) Speakman Company.
    - 5) T&S Brass and Bronze Works, Inc.
  - b. Source Limitations: Obtain sink faucets from single source from single manufacturer.
  - c. Standards:
    - 1) ASME A112.18.1/CSA B125.1.
    - 2) NSF 61.
    - 3) NSF 372.
  - d. Description: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
  - e. Characteristics: See schedule on drawings.
  - f. Maximum Flow Rate: 1.5 gpm.
  - g. Mounting Type: Deck.
  - h. Spout Outlet: Aerator; Spray.
2. Sink Faucets, Manually Operated - Service Sink MSB-1:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Acorn Engineering Company; a Division of Morris Group International.
    - 2) Chicago Faucets; Geberit Group.
    - 3) Kohler Co.
    - 4) Speakman Company.
    - 5) T&S Brass and Bronze Works, Inc.
    - 6) Zurn Industries, LLC.
  - b. Source Limitations: Obtain sink faucets from single source from single manufacturer.
  - c. Description: Wall/back mounted, brass body, with integral service stops, checks, spout with bucket/pail hook, 3/4-inch hose thread end, integral vacuum breaker, inlets 8 inches o.c., and two-handle mixing.
  - d. Faucet:

- 1) Standards:
  - a) ASME A112.18.1/CSA B125.1.
  - b) NSF 61 and NSF 372.
  - c) ICC A117.1.
  - d) ASSE 1001 (VB).
- 2) Finish: Rough chrome plated.
- 3) Characteristics: See schedule on drawings.
- 4) Brace: Adjustable top brace.
- e. Vacuum Breaker: Required for hose outlet.
- f. Spout Outlet: Hose thread in accordance with ASME B1.20.7.

D. Sink Supply Fittings:

1. NSF Standard: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.
2. Standard: ASME A112.18.1/CSA B125.1.
3. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless steel wall flange.
4. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
5. Operation: Loose key.

E. Grout:

1. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
2. Characteristics: Nonshrink; recommended for interior and exterior applications.
3. Design Mix: 5000 psi, 28-day compressive strength.
4. Packaging: Premixed and factory packaged.

## 2.5 COMMERCIAL URINALS

A. Urinals, Wall Hung:

1. Urinals, Wall Hung - Back Outlet, Washdown UR-1:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) American Standard.
    - 2) Kohler Co.
    - 3) Sloan Valve Company
    - 4) TOTO USA, INC.

- 5) Zurn Industries, LLC.
- b. Fixture:
  - 1) Standards:
    - a) ASME A112.19.2/CSA B45.1.
    - b) ASME A112.19.5/CSA B45.15.
  - 2) Material: Vitreous china.
  - 3) Type: Washdown with extended shields.
  - 4) Strainer or Trapway: Manufacturer's standard strainer with integral trap.
  - 5) Water Consumption: 0.125 gpf.
  - 6) Spud Size and Location: NPS 3/4, top.
  - 7) Outlet Size and Location: NPS 2, back.
  - 8) Color: White.
- c. Flushometer Valve: UR-1.
- d. Waste Fitting:
  - 1) Standard: ASME A112.18.2/CSA B125.2 for coupling.
  - 2) Size: NPS 2.
- e. Support: Urinal carrier, floor affixed with steel uprights with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture.
- f. Urinal Mounting Height: Standard, Accessible in accordance with ICC A117.1.

## 2.6 COMMERCIAL WATER CLOSETS

### A. Water Closets, Wall Mounted:

- 1. Water Closets, Wall Mounted - Top Spud WC-1:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) American Standard.
    - 2) Kohler Co.
    - 3) Sloan Valve Company.
    - 4) TOTO USA, INC.
    - 5) Zurn Industries, LLC.
  - b. Source Limitations: Obtain water closets from single source from single manufacturer.
  - c. Standard: ASME A112.19.2/CSA B45.1.
  - d. Bowl:
    - 1) Material: Vitreous china.
    - 2) Type: Siphon jet.
    - 3) Style: Flushometer valve.



- 4) Mounting Height: Standard Accessible in accordance with ICC A117.1.
- 5) Rim Contour: Elongated.
- 6) Water Consumption: 1.28 gal. per flush.
- 7) Spud Size and Location: NPS 1-1/2; top.
- 8) Color: White.
- e. Flushometer Valve: WC-1.
- f. Toilet Seat: WC-1.
- g. Support: Water-closet carrier, floor affixed.

## 2.7 FLUSHOMETER VALVES

### A. Urinal Flushometer Valves, Sensor Operated - Piston, Battery Powered UR-1:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Standard.
  - b. Kohler Co.
  - c. Sloan Valve Company.
  - d. TOTO USA, INC.
  - e. Zurn Industries, LLC.
- 2. Source Limitations: Obtain flushometer valve from single source from single manufacturer.
- 3. Standard: ASSE 1037/ASME 112.1037/CSA B125.37.
- 4. Minimum Pressure Rating: 125 psig.
- 5. Features: Include integral check stop and backflow-prevention device.
- 6. Material: Brass body with corrosion-resistant components.
- 7. Style: Exposed.
- 8. Exposed Flushometer-Valve Finish: Chrome plated.
- 9. Panel Finish: Chrome-plated or stainless steel.
- 10. Trip Mechanism: Battery-powered electronic sensor; listed and labeled as defined in NFPA 70, by qualified testing agency, and marked for intended location and application.
- 11. Consumption: 0.125 gal. per flush.
- 12. Minimum Inlet: NPS 3/4.
- 13. Minimum Outlet: NPS 3/4.

### B. Water Closet Flushometer Valves, Sensor Operated - Piston, Battery Powered WC-1:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Standard.
  - b. Kohler Co.
  - c. Sloan Valve Company.
  - d. TOTO USA, INC.
  - e. Zurn Industries, LLC.

2. Source Limitations: Obtain flushometer valve from single source from single manufacturer.
3. Standard: ASSE 1037/ASME 112.1037/CSA B125.37.
4. Minimum Pressure Rating: 125 psig.
5. Features: Include integral check stop and backflow-prevention device.
6. Material: Brass body with corrosion-resistant components.

7. Style: Exposed.
8. Exposed Flushometer-Valve Finish: Chrome plated.
9. Panel Finish: Chrome-plated or stainless steel.
10. Trip Mechanism: Battery-powered electronic sensor; listed and labeled as defined in NFPA 70, by qualified testing agency, and marked for intended location and application.
11. Consumption: 1.28 gal. per flush.
12. Minimum Inlet: NPS 1.
13. Minimum Outlet: NPS 1-1/4.

## 2.8 TOILET SEATS

### A. Toilet Seats WC-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Standard.
  - b. Bemis Manufacturing Company.
  - c. Church Seats; Bemis Manufacturing Company.
  - d. Kohler Co.
  - e. TOTO USA, INC.
  - f. Zurn Industries, LLC.
2. Source Limitations: Obtain toilet seat from single source from single manufacturer.
3. Standard: IAPMO/ANSI Z124.5.
4. Material: Plastic.
5. Type: Commercial (Heavy duty).
6. Shape: Elongated rim, open front.
7. Hinge: Self-sustaining, check.
8. Hinge Material: Noncorroding metal.
9. Seat Cover: Not required.
10. Color: White.
11. Surface Treatment: Antimicrobial.

## 2.9 FIXTURE CARRIERS

A. Fixture Carriers - Lavatory LAV-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Jay R. Smith Mfg Co; a division of Morris Group International.
  - b. Josam Company.
  - c. MIFAB, Inc.
  - d. WATTS; A Watts Water Technologies Company.
  - e. Wade; a subsidiary of McWane Inc.
  - f. Zurn Industries, LLC.
2. Source Limitations: Obtain lavatory carriers from single source from single manufacturer.
3. Standards:
  - a. ASME A112.6.1M.
  - b. ASME A112.6.2.

B. Fixture Carriers - Urinal UR-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Jay R. Smith Mfg Co; a division of Morris Group International.
  - b. Josam Company.
  - c. MIFAB, Inc.
  - d. WATTS; A Watts Water Technologies Company.
  - e. Wade; a subsidiary of McWane Inc.
  - f. Zurn Industries, LLC.
2. Source Limitations: Obtain urinal carriers from single source from single manufacturer.
3. Standard: ASME A112.6.1M.
4. Description: Waste-fitting assembly, as required to match drainage piping material and arrangement with faceplates, couplings, gaskets, and feet; bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

C. Fixture Carriers - Water Closet WC-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Jay R. Smith Mfg Co; a division of Morris Group International.

- b. Josam Company.
  - c. MIFAB, Inc.
  - d. WATTS; A Watts Water Technologies Company.
  - e. Wade; a subsidiary of McWane Inc.
  - f. Zurn Industries, LLC.
- 2. Source Limitations: Obtain water closet carriers from single source from single manufacturer.
  - 3. Standard: ASME A112.6.1M.
  - 4. Description: Waste-fitting assembly, as required to match drainage piping material and arrangement with faceplates, couplings, gaskets, and feet; bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine roughing-in of water-supply piping and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.
- B. Examine walls and floors for suitable conditions where plumbing fixtures will be installed.
- C. Examine counters for suitable conditions where lavatories and sinks will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION OF COMMERCIAL PLUMBING FIXTURES

- A. Lavatory Installation:
  - 1. Install lavatories level and plumb in accordance with roughing-in drawings.
  - 2. Install supports, affixed to building substrate, for wall-mounted lavatories.
  - 3. Install accessible, wall-mounted lavatories at mounting height in accordance with ICC A117.1.
  - 4. Install water-supply piping with stop on each supply to each lavatory faucet. Install stops in locations that are accessible for ease of operation.
  - 5. Install trap and waste piping on each drain outlet of each lavatory to be connected to sanitary drainage system.
  - 6. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings.

Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."

7. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
8. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

B. Shower Installation:

1. Assemble shower components in accordance with manufacturers' written instructions.
2. Install showers level and plumb in accordance with roughing-in drawings.
3. Install ball valves in water-supply piping to the shower if supply stops are specified with the shower valve. Comply with ball valve requirements specified in Section 220523 "General Duty Valves for Plumbing Piping." Install valves in locations that are accessible for ease of operation.
4. Install shower flow-control fittings with specified maximum flow rates in shower arms.
5. Set shower receptors in leveling bed of cement grout.
6. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."
7. Seal joints between showers, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

C. Sink Installation:

1. Install sinks level and plumb in accordance with roughing-in drawings.
2. Install supports, affixed to building substrate, for wall-mounted sinks.
3. Install accessible, wall-mounted sinks at mounting height in accordance with ICC A117.1.
4. Set floor-mounted sinks in leveling bed of cement grout.
5. Install water-supply piping with stop on each supply to each sink faucet.
  - a. Exception: Use ball or gate valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523 "General Duty Valves for Plumbing Piping."
  - b. Install stops/valves in locations that are accessible for ease of operation.
6. Install trap and waste piping on each drain outlet of each sink to be connected to sanitary drainage system.
7. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings.

Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."

8. Seal joints between sinks, counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
9. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

D. Urinal Installation:

1. Install urinals level and plumb in accordance with roughing-in drawings.
2. Install wall-hung, back-outlet urinals onto waste-fitting seals and attached to supports.
3. Install wall-hung, bottom-outlet urinals with tubular waste piping attached to supports.
4. Install accessible, wall-mounted urinals at mounting height in accordance with ICC A117.1.
5. Install trap-seal liquid in waterless urinals.
6. Install supports, affixed to building substrate, for wall-hung urinals.
7. Use off-floor carriers with waste fitting and seal for back-outlet urinals.
8. Use carriers without waste fitting for urinals with tubular waste piping.
9. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.
10. Measure support height installation from finished floor, not structural floor.
11. Install flushometer-valve, water-supply fitting on each supply to each urinal.
12. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
13. Install lever-handle flushometer valves for accessible urinals with handle mounted on open side of compartment.
14. Install actuators in locations easily reachable for people with disabilities.
15. Install new batteries in battery-powered, electronic-sensor mechanisms.
16. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Install deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."
17. Seal joints between urinals, walls, and floors using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to urinal color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

E. Water Closet Installation:

1. Install water closets level and plumb in accordance with roughing-in drawings.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
3. Install accessible, wall-mounted water closets at mounting height in accordance with ICC A117.1.

4. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
5. Use carrier supports with waste-fitting assembly and seal.
6. Install floor-mounted, back-outlet water closets, attached to building floor substrate, onto waste-fitting seals; and attach to support.
7. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals, and affix to building substrate.
8. Measure support height installation from finished floor, not structural floor.
9. Install flushometer-valve, water-supply fitting on each supply to each water closet.
10. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
11. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
12. Install actuators in locations easily reachable for people with disabilities.
13. Install new batteries in battery-powered, electronic-sensor mechanisms.
14. Install toilet seats on water closets.
15. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Install deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."
16. Seal joints between water closets, walls, and floors using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to water-closet color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

### 3.3 INSTALLATION OF PIPING CONNECTIONS

- A. Connect plumbing fixtures with water supplies and soil, waste, and vent piping. Use size fittings required to match plumbing fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil, waste, and vent piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."
- D. Install protective-shielding pipe covers and enclosures on exposed supplies and waste piping of accessible plumbing fixtures. Comply with requirements in Section 220719 "Plumbing Piping Insulation."
- E. Where installing piping adjacent to water closets and urinals, allow space for service and maintenance.



### 3.4 INSTALLATION OF ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted in accordance with NFPA 70 and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
  - 1. Nameplate to be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
  - 2. Nameplate to be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

### 3.5 INSTALLATION OF CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

### 3.6 ADJUSTING

- A. Operate and adjust plumbing fixtures and controls. Replace damaged and malfunctioning plumbing fixtures, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.
- C. Adjust water pressure at shower valves to produce proper flow.
- D. Adjust water pressure at flushometer valves to produce proper flow.
- E. Install new batteries in battery-powered, electronic-sensor mechanisms.

### 3.7 CLEANING AND PROTECTION

- A. After completing installation of plumbing fixtures, inspect and repair damages finishes. Replace any fixtures unable to be repaired to the satisfaction of the Owner.

- B. Clean plumbing fixtures and associated faucets, valves, flushometer valves, and fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed plumbing fixtures and associated faucets, valves, flushometer valves, and fittings.
- D. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224200

## SECTION 224700 - DRINKING FOUNTAINS AND WATER COOLERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Water coolers.
2. Fixture carriers.

#### 1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.
  - a. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  - b. Include operating characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and mounting details.
2. Include details of fixture assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power wiring.

- C. Delegated Design Submittals: For vibration isolation and supports, indicated to comply with performance requirements and design criteria, including analysis data.

### 1.3 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For remote water coolers, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For water coolers, to include in maintenance manuals.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include servicing and adjustment of electronic-sensor fixtures.

### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Filter Cartridges: Equal to 50 percent of quantity installed for each type and size indicated, but no fewer than 2 of each.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's written instructions for delivery, storage, and handling.

1.7 WARRANTY

- A. Manufacturer Warranty: Manufacturer and Installer agree to repair or replace water coolers with bottle fillers that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Standards:
  - 1. Drinking fountains, water coolers, bottle filling stations, and remote water coolers intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), requirements of the authority having jurisdiction, and with NSF 61 or NSF 372, or be certified in compliance with NSF 61 or NSF 372 by an ANSI-accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
- B. Delegated Design:

1. Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design vibration isolation, supports,, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
2. Product manufacturer's qualified staff to select and size products to achieve specified performance requirements.

## 2.2 WATER COOLERS

### A. Water Coolers - Surface Wall Mounted, Stainless Steel EWC-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Elkay.
  - b. Halsey Taylor.
  - c. Murdock Manufacturing; A Division of Morris Group International.
  - d. Oasis International.
2. Source Limitations: Obtain surface wall-mounted, stainless steel, water coolers from single source from single manufacturer.
3. Standards:
  - a. NSF 61.

- b. NSF 372.
  - c. ASME A112.19.3/CSA B45.4.
  - d. ASHRAE 18.
  - e. UL 399.
  - f. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- 4. Type: Vandal resistant.
- 5. Bubbler: One, with adjustable stream regulator, located on each cabinet deck.
- 6. Control: Push bar.
- 7. Bottle Filler: Sensor activation, with 20-second automatic shutoff timer: Fill rate is 0.5 to 1.5 gpm.
- 8. Drain: Grid with NPS 1-1/4 tailpiece.
- 9. Supply: NPS 3/8 with shutoff valve.
- 10. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 brass P-trap.
- 11. Filter: One or more water filters with capacity sized for unit peak flow rate.
  - a. Standards:
    - 1) NSF 42.
    - 2) NSF 53.
- 12. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
- 13. Support: Fixture carrier.
- 14. Water-Cooler Mounting Height: High/low - standard/accessible in accordance with ICC A117.1.
- 15. Capacities and Characteristics:
  - a. Cooled Water: 8 gph.
  - b. Ambient-Air Temperature: 90 deg F.
  - c. Inlet-Water Temperature: 80 deg F.
  - d. Cooled-Water Temperature: 50 deg F.
  - e. Electrical Characteristics:
    - 1) Motor Horsepower: 1/3.
    - 2) Volts: 120 V ac.
    - 3) Phase: Single.
    - 4) Hertz: 60 Hz.

## 2.3 FIXTURE CARRIERS

### A. Fixture Carriers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Jay R. Smith Mfg Co; a division of Morris Group International.
  - b. Josam Company.
  - c. MIFAB, Inc.
  - d. WATTS; A Watts Water Technologies Company.
  - e. Wade; a subsidiary of McWane Inc.
  - f. Zurn Industries, LLC.
2. Standard: ASME A112.6.1M.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.
- B. Examine walls and floors for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install fixtures level and plumb in accordance with roughing-in drawings. For fixtures indicated for juveniles, install at height required by authorities having jurisdiction.
- B. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.
- C. Install mounting frames, affixed to building construction, and attach recessed water coolers and bottle filling stations to mounting frames.
- D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523 "General-Duty Valves for Plumbing Piping."
- E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."



- G. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

### 3.3 PIPING CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Install ball shutoff valve on water supply to each fixture.. Install valve upstream from filter for drinking fountain, water cooler, and bottle filling station. Comply with valve requirements specified in Section 220523 "General-Duty Valves for Plumbing Piping."
- D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

### 3.4 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
  - 1. Nameplates to be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
  - 2. Nameplates to be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.5 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.
- B. Adjust water cooler temperature settings.
- C. Adjust electronic-sensor settings.

3.6 CLEANING

- A. After installing fixtures, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean fixtures, on completion of installation, in accordance with manufacturer's written instructions.
- C. Provide protective covering for installed fixtures.
- D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224700

## SECTION 227019 - FACILITY NATURAL-GAS PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Joining materials.
4. Manual gas shutoff valves.
5. Pressure regulators.
6. Service meters.
7. Dielectric fittings.

#### 1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. An example includes rooftop locations.
- C. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- D. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.

#### 1.3 ACTION SUBMITTALS

##### A. Product Data:

1. Piping specialties.

2. Corrugated, stainless steel tubing with associated components.
  3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
  4. Pressure regulators. Indicate pressure ratings and capacities.
  5. Dielectric fittings.
- B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
1. Detail mounting, supports, and valve arrangements for service-meter assembly and pressure regulator assembly.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.
- B. Welding certificates.
- C. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.
- D. Field quality-control reports.
- E. Qualification Statements: For professional engineer.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For pressure regulators and service meters to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Steel Support Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators in accordance with the ASME Boiler and Pressure Vessel Code.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping in accordance with requirements of authorities having jurisdiction.
- B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.
- D. Protect stored PE pipes and valves from direct sunlight.

1.8 PROJECT CONDITIONS

- A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

1.9 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

- B. Coordinate requirements for access panels and doors for valves installed and concealed behind finished surfaces. Comply with requirements in Section 083113 "Access Doors and Frames."
- C. Coordinate requirements for piping identification for natural-gas piping. Comply with requirements in Section 220553 "Identification of Plumbing Piping and Equipment."

## PART 2 - PRODUCTS

### 2.1 SOURCE LIMITATIONS

- A. Obtain each product type from single source from single manufacturer.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Comply with the International Fuel Gas Code.
- B. Minimum Operating-Pressure Ratings:
  - 1. Piping and Valves: 100 psig minimum unless otherwise indicated.
  - 2. Service Regulators: 100 psig minimum unless otherwise indicated.
- C. Natural-Gas System Pressure within Buildings:

1. Single Pressure: More than 2 psig, but not more than 5 psig.
- 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.

## 2.3 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A53/A53M, black steel, Schedule 40, Type E or S, Grade B.
  1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
  2. Wrought-Steel Welding Fittings: ASTM A234/A234M for butt welding and socket welding.
  3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
  4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
    - a. Material Group: 1.1.
    - b. End Connections: Threaded or butt welding to match pipe.
    - c. Lapped Face: Not permitted underground.
    - d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum O-rings, and spiral-wound metal gaskets.
    - e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.
  5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
    - a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.
- B. PE Pipe: ASTM D2513, SDR 11.
  1. PE Fittings: ASTM D2683, socket-fusion type or ASTM D3261, butt-fusion type with dimensions matching PE pipe.

2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D2513, SDR 11; and steel pipe complying with ASTM A53/A53M, black steel, Schedule 40, Type E or S, Grade B.
3. Anodeless Service-Line Risers: Factory fabricated and leak tested.
  - a. Underground Portion: PE pipe complying with ASTM D2513, SDR 11 inlet.
  - b. Casing: Steel pipe complying with ASTM A53/A53M, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering. Vent casing aboveground.
  - c. Aboveground Portion: PE transition fitting.
  - d. Outlet is threaded or flanged or suitable for welded connection.
  - e. Tracer wire connection.
  - f. UV shield.
  - g. Stake supports with factory finish to match steel pipe casing or carrier pipe.
4. Transition Service-Line Risers: Factory fabricated and leak tested.
  - a. Underground Portion: PE pipe complying with ASTM D2513, SDR 11 inlet connected to steel pipe complying with ASTM A53/A53M, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.
  - b. Outlet is threaded or flanged or suitable for welded connection.
  - c. Bridging sleeve over mechanical coupling.
  - d. Factory-connected anode.
  - e. Tracer wire connection.
  - f. UV shield.
  - g. Stake supports with factory finish to match steel pipe casing or carrier pipe.

## 2.4 PIPING SPECIALTIES



A. Y-Pattern Strainers:

1. Body: ASTM A126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 60-mesh startup strainer, and perforated stainless steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

2.5 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural gas.
- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.6 MANUAL GAS SHUTOFF VALVES

- A. General Requirements for Metallic Valves, NPS 2 (DN 50) and Smaller: Comply with ASME B16.33.
1. CWP Rating: 125 psig.
  2. Threaded Ends: Comply with ASME B1.20.1.
  3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
  4. Tamperproof Feature: Locking feature for valves indicated in "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles.
  5. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
  6. Service Mark: Valves NPS 1-1/4 to NPS 2 having initials "WOG" permanently marked on valve body.
- B. General Requirements for Metallic Valves, NPS 2-1/2 (DN 65) and Larger: Comply with ASME B16.38.
1. CWP Rating: 125 psig.
  2. Flanged Ends: Comply with ASME B16.5 for steel flanges.

3. Tamperproof Feature: Locking feature for valves indicated in "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles.
  4. Service Mark: Initials "WOG" permanently marked on valve body.
- C. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. A.Y. McDonald Mfg. Co.
    - b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
    - c. BrassCraft Manufacturing Co.; a Masco company.
    - d. R.W. Lyall; brand of Hubbell Utility Solutions; Hubbell Incorporated.
  2. Body: Bronze, complying with ASTM B584.
  3. Ball: Chrome-plated bronze.
  4. Stem: Bronze; blowout proof.
  5. Seats: Reinforced TFE; blowout proof.
  6. Packing: Threaded-body packnut design with adjustable-stem packing.
  7. Ends: Threaded, flared, or socket as indicated in "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles.
  8. CWP Rating: 600 psig.
  9. Listing: Valves NPS 1 and smaller are to be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- D. Cast-Iron, Nonlubricated Plug Valves: MSS SP-78.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. A.Y. McDonald Mfg. Co.
    - b. Mueller Co. LLC; Mueller Water Products, Inc.
    - c. XOMOX; Crane ChemPharma & Energy.
  2. Body: Cast iron, complying with ASTM A126, Class B.
  3. Plug: Bronze or nickel-plated cast iron.
  4. Seat: Coated with thermoplastic.
  5. Stem Seal: Compatible with natural gas.
  6. Ends: Threaded or flanged as indicated in "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles.
  7. Operator: Square head or lug type with tamperproof feature where indicated.
  8. Pressure Class: 125 psig.
  9. Listing: Valves NPS 1 and smaller are to be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- E. Cast-Iron, Lubricated Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. A.Y. McDonald Mfg. Co.
  - b. Mueller Co. LLC; Mueller Water Products, Inc.
  - c. R & M Energy Systems; Robbins & Myers.
2. Body: Cast iron, complying with ASTM A126, Class B.
3. Plug: Bronze or nickel-plated cast iron.
4. Seat: Coated with thermoplastic.
5. Stem Seal: Compatible with natural gas.
6. Ends: Threaded or flanged as indicated in "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles.
7. Operator: Square head or lug type with tamperproof feature where indicated.
8. Pressure Class: 125 psig.
9. Listing: Valves NPS 1 and smaller are to be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

## 2.7 PRESSURE REGULATORS

### A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

### B. Service Pressure Regulators: Comply with ANSI Z21.80A.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Actaris: a brand of ITT Controls.
  - b. Fischer; Emerson Electric Co., Automation Solutions.
  - c. Itron Inc.
  - d. Schneider Electric USA, Inc.
2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: NBR; resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: UV-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to regulator.

9. Pressure regulator is to maintain discharge pressure setting downstream and is to not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 100 psig.

C. Line Pressure Regulators: Comply with ANSI Z21.80A.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Actaris: a brand of ITT Controls.
  - b. Eclipse Innovative Thermal Technologies.
  - c. Fischer; Emerson Electric Co., Automation Solutions.
  - d. Itron Inc.
  - e. Maxitrol Company.
  - f. Schneider Electric USA, Inc.
2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: NBR; resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: UV-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to regulator.
9. Pressure regulator is to maintain discharge pressure setting downstream and is to not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 5 psig.

D. Appliance Pressure Regulators: Comply with ANSI Z21.18.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Canadian Meter Company, LLC; a Honeywell Company.
  - b. Dormont; A Watts Water Technologies Company.
  - c. Eaton.
  - d. Maxitrol Company.
2. Body and Diaphragm Case: Die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.

5. Seat Disc: NBR.
6. Seal Plug: UV-stabilized, mineral-filled nylon.
7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
9. Maximum Inlet Pressure: 5 psig.

## 2.8 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Flanges:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Capitol Manufacturing Company.
    - b. GF Piping Systems: Georg Fischer LLC.
    - c. Matco-Norca.
    - d. WATTS; A Watts Water Technologies Company.
    - e. Wilkins.
  2. Description:
    - a. Standard: ASSE 1079.
    - b. Factory-fabricated, bolted, companion-flange assembly.
    - c. Pressure Rating: 150 psig.
    - d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- C. Dielectric-Flange Insulating Kits:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Advance Products & Systems, LLC.
    - b. CALPICO, Inc.
    - c. GF Piping Systems: Georg Fischer LLC.
    - d. GPT; a division of EnPRO Industries.
  2. Description:
    - a. Nonconducting materials for field assembly of companion flanges.
    - b. Pressure Rating: 150 psig.
    - c. Gasket: Neoprene or phenolic.
    - d. Bolt Sleeves: Phenolic or polyethylene.
    - e. Washers: Phenolic with steel backing washers.

2.9 LABELING AND IDENTIFYING

- A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description and rated pressure of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.
- B. Label and identify gas piping and pressure outside a multitenant building by tenant.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Close equipment shutoff valves before turning off natural gas to premises or piping section.
- B. Inspect natural-gas piping in accordance with the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.
- C. Comply with the International Fuel Gas Code requirements for preventing accidental ignition.

3.3 INSTALLATION OF OUTDOOR PIPING

- A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.

- B. Install underground, natural-gas piping buried at least 36 inches below finished grade. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.
  - 1. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.
- C. Install underground, PE, natural-gas piping in accordance with ASTM D2774.
- D. Steel Piping with Protective Coating:
  - 1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
  - 2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
  - 3. Replace pipe having damaged PE coating with new pipe.
- E. Install fittings for changes in direction and branch connections.
- F. Install pressure gauge upstream and downstream from each service regulator. Pressure gauges are specified in Section 230500 "Common Work Results for HVAC."

### 3.4 INSTALLATION OF INDOOR PIPING

- A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Do not install piping in concealed locations unless sleeved with the sleeve open at both ends.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

- F. Where installing piping above accessible ceilings, allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access. Do not locate valves within return air plenums.
- H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Verify final equipment locations for roughing-in.
- L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
  - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
  - 2. Install sediment trap on both sides of regulators for gas reduction to 2 psig with valve and cap.
- N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.
- P. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.
  - 1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.



2. In Floors: Install natural-gas piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2 inches of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.
  3. In Floor Channels: Install natural-gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.
  4. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.
    - a. Exception: Tubing passing through partitions or walls does not require striker barriers.
  5. Prohibited Locations:
    - a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
    - b. Do not install natural-gas piping in solid walls or partitions.
- Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- R. Connect branch piping from top or side of horizontal piping.
- S. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.
- T. Do not use natural-gas piping as grounding electrode.
- U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- V. Install pressure gauge upstream and downstream from each line regulator. Pressure gauges are specified in Section 230500 "Common Work Results for HVAC."
- W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230500 "Common Work Results for HVAC."
- X. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230500 "Common Work Results for HVAC."
- Y. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230500 "Common Work Results for HVAC."

### 3.5 INSTALLATION OF SERVICE-METER ASSEMBLIES

- A. Install service-meter assemblies aboveground, on concrete bases.
- B. Install metal shutoff valves upstream from service regulators. Shutoff valves are not required at second regulators if two regulators are installed in series.
- C. Install strainer on inlet of service-pressure regulator and meter set.
- D. Install service regulators mounted outside with vent outlet horizontal or facing down. Install screen in vent outlet if not integral with service regulator.
- E. Install metal shutoff valves upstream from service meters. Install dielectric fittings downstream from service meters.
- F. Install service meters downstream from pressure regulators.
- G. Install metal bollards to protect meter assemblies. Comply with requirements in Section 055000 "Metal Fabrications" for pipe bollards.

### 3.6 INSTALLATION OF VALVES

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless steel tubing, aluminum, or copper connector.
- B. Install underground valves with valve boxes.
- C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.
- D. Install earthquake valves aboveground outside buildings according to listing.
- E. Install anode for metallic valves in underground PE piping.
- F. Do not install valves in return-air plenums.

### 3.7 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
2. Cut threads full and clean using sharp dies.
3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints:

1. Construct joints in accordance with AWS D10.12/D10.12M, using qualified processes and welding operators.
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Brazed Joints: Construct joints in accordance with AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

F. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

G. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, and then use wrench. Do not overtighten.

H. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join in accordance with ASTM D2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

### 3.8 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
- B. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hangers, supports, and anchor devices.
- C. Install hangers for steel piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Install hangers for corrugated stainless steel tubing, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

- E. Support horizontal piping within 12 inches of each fitting.
- F. Support vertical runs of steel piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- G. Support vertical runs of corrugated stainless steel tubing to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

### 3.9 PIPING CONNECTIONS

- A. Connect to utility's gas main according to utility's procedures and requirements.
- B. Install natural-gas piping electrically continuous, and bonded to gas-appliance equipment grounding conductor of the circuit powering the appliance in accordance with NFPA 70.
- C. Where installing piping adjacent to appliances, allow space for service and maintenance of appliances.
- D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

### 3.10 LABELING AND IDENTIFICATION

- A. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for piping and valve identification.
- B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

### 3.11 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base.
  - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.

2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Use 5000 psig, 28-day, compressive-strength concrete and reinforcement as specified in Section 033000 "Cast-in-Place Concrete."

### 3.12 FIELD QUALITY CONTROL

#### A. Tests and Inspections:

1. Test, inspect, and purge natural gas in accordance with the International Fuel Gas Code and authorities having jurisdiction.
2. Natural-gas piping will be considered defective if it does not pass tests and inspections.

#### B. Prepare test and inspection reports.

### 3.13 OUTDOOR PIPING SCHEDULE

#### A. Underground natural-gas piping is to be the following:

1. PE pipe and fittings joined by heat fusion, or mechanical couplings; service-line risers with tracer wire terminated in an accessible location.

#### B. Aboveground natural-gas piping is to be the following:

1. Steel pipe with wrought-steel fittings and welded joints.

- 3.14 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG (3.45 kPa)
- A. Aboveground, branch piping NPS 2 and smaller is to be the following:
    - 1. Steel pipe with malleable-iron fittings and threaded joints.
  - B. Aboveground, distribution piping is to be the following:
    - 1. Steel pipe with wrought-steel fittings and welded joints.
- 3.15 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 0.5 PSIG (3.45 kPa) AND LESS THAN 5 PSIG (34.5 kPa)
- A. Aboveground, branch piping NPS 1 and smaller is to be the following:
    - 1. Steel pipe with malleable-iron fittings and threaded joints.
  - B. Aboveground, distribution piping is to be the following:
    - 1. Steel pipe with steel welding fittings and welded joints.

3.16 ABOVEGROUND, MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Valves for pipe sizes NPS 2 and smaller at service meter are to be the following:
  - 1. Cast-iron, nonlubricated plug valve.
- B. Valves for pipe sizes NPS 2-1/2 and larger at service meter are to be the following:
  - 1. Cast-iron, nonlubricated plug valve.
- C. Distribution piping valves for pipe sizes NPS 2 and smaller are to be the following:
  - 1. Two-piece, full-port, bronze ball valves with bronze trim.
- D. Distribution piping valves for pipe sizes NPS 2-1/2 and larger are to be the following:
  - 1. Cast-iron, lubricated plug valve.
- E. Valves in branch piping for single appliance are to be the following:
  - 1. Two-piece, full-port, bronze ball valves with bronze trim.

END OF SECTION 231123

## **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 and all Division 23 Sections.
- B. Refer to Specification Section 019113 – General Commissioning Requirements for additional requirements.

### **1.2 PLANS AND SPECIFICATIONS**

- A. All work under this title, on drawings or specified, is subject to the general and special contract conditions for the entire project, and the contractor for this portion of the work is required to refer especially thereto, and to the architectural drawings.
- B. Drawings are diagrammatic and specifications are complementary and must be so interpreted to determine the full scope of work under this heading. Wherever any material, article, operation, or method is either specified or shown on the drawings, this contractor is required to provide each item and perform each prescribed operation according to the designate quality, qualification or condition, furnishing all necessary labor, equipment or incidentals.
- C. Wherever the designation "Architect" appears, it shall imply Architect or Engineer. Wherever the term "Contractor" or "MC" appears, it shall imply the Contractor responsible for Division 23, Mechanical Work.

### **1.3 CONFLICTS**

- A. If, in the interpretation of contract documents, it appears that the drawings and specifications are not in agreement, the Contractor is to contact the Engineer. The Engineer shall be the final authority. Addenda supersede the provisions which they amend.
- B. In the absence of a written clarification by the engineer, the Contractor must install his work in accordance with the more stringent and/or costly condition. Contractor assumes full responsibility for any and all items furnished and installed without the written approval by the Architect or Engineer. Under no circumstances will a change order be approved for work installed that was not approved by the Architect or Engineer.

### **1.4 DIMENSIONS, LAYOUTS AND OBSTACLES**

- A. Verify dimensions and elevations from actual field measurements after building construction has sufficiently progressed.
- B. Assume full and final responsibility for the accuracy of any or all work performed under this Division and make repairs and corrections as required or directed at no extra cost to the Owner.
- C. Layouts of piping, ductwork, and equipment shown on drawings are diagrammatic. Contractor shall verify dimensions and layouts for specific project conditions, field verify any existing conditions, and coordinate with all other trades prior to procurement, fabrication and installation of equipment and material. Existing Conditions shall be field verified by contractor prior to bid submissions. Unknown conditions during construction due to omission of contractor field verification prior to bid shall be resolved by the contractor at no cost to the owner or project. Contractor assumes full responsibility for completeness of installation including coordination of work with other trades.
- D. Make actual installations in accord with design layouts, but with necessary adjustments as determined by trade coordination, actual material and equipment procured, field verifications, and other project conditions in order to provide a fully functional and complete system, save and maintainable in all aspects. Any such required adjustments and deviations shall require specific approval of the Engineer/Architect prior to procurement, fabrication, and installation.
- E. Take particular care to coordinate all piping, ductwork, and equipment under this Division to prevent conflict and remove and relocate work as may be made necessary by such conflict at no extra cost to the Owner or project.



- F. Unless expressly permitted by the Engineer/Architect or shown otherwise on the Drawings, all piping, ducts and similar items shall be installed so that they are concealed except as permitted by the Engineer/Architect in service rooms noted on the Drawings.
- G. The Owner or Owner's Representative reserves the right to relocate terminal equipment six (6) feet in any direction from locations indicated on plans, before roughing-in, with no extra cost to the Owner or project.

#### **1.5 REVIEW OF PROPOSED EQUIPMENT AND MATERIALS**

- A. Submittals:
  - 1. Contractor shall submit a complete list and schedule, including all proposed equipment and materials to the Construction Manager and Engineer for review and approval within 10 business days of contract award.
  - 2. Submit all proposed material, equipment, and fabrication shop drawings to the Engineer for approval prior to procurement, fabrication, and installation.
- B. Substitution Requests:
  - 1. Substitutions are defined as any manufacturer and/or model not indicated in drawings or specifications as the "basis of design". Requests for substitutions must be made in writing ten (10) days prior to bid date so that an addendum may reach all contractors.
  - 2. In addition to other contract provisions regarding substitution requests, Contractor must certify by letter that he has checked the proposed substitution products or materials for conformance to applicable codes, standards, and regulations, specifications, and space limitations and assumes full responsibility thereafter.
  - 3. Approval of substitution requests is at the sole discretion of the Engineer and Owner.
  - 4. If substitutions are proposed after the bids are received, the Contractor shall state amount of credit to the Owner for substitution. Substitutions that are considered equal by the Contractor and carried in bid without approval by Engineer shall be the responsibility of the Contractor. The Engineer and/or Owner shall not be made liable or responsible for losses incurred by the Contractor, due to the rejection of said items for installation.
  - 5. Where equipment requiring different arrangement or connections other than as indicated is acceptable, it shall be the responsibility of this Contractor to furnish revised layouts, and install the equipment to operate properly and in harmony with the intent of the drawings and specifications. All changes in the work required by the different arrangement shall be done at no additional cost to the Owner or Project, including but not limited to structural steel modifications. Control and power wiring modifications required by Contractor, imposed modifications, and the additional cost of these modifications, shall be the responsibility of this Contractor.
  - 6. Where "basis of design" equipment manufacturer and model number is indicated on the drawings, any proposed substitution must match the "basis of design" product performance, efficiencies, ratings, materials of construction, dimensions, and weight, whether or not this information is included in the written specifications.

#### **1.6 PERMITS, CODES AND ORDINANCES**

- A. The Contractor shall arrange and pay for all permits, inspections, etc., as required by local utilities or applicable agencies.
- B. All work and material shall be in complete accordance with the ordinances, regulations, codes, etc., of all political entities exercising jurisdictions.

#### **1.7 QUALITY ASSURANCE**

- A. Install HVAC Systems in accordance with applicable industry standards.
- B. Install HVAC Systems in accordance with manufacturer's installation, operations and maintenance instructions.

### **1.8 COORDINATION WITH OTHER TRADES**

- A. Check mechanical drawings with all other trades including electrical, plumbing, fire protection and general construction.
- B. Anticipate, avoid, and resolve interferences with other trades.
- C. Take particular care to coordinate all piping, ductwork, plumbing and major electrical components above ceiling, to prevent conflict. Remove and relocate work as may be made necessary by such conflict, at no extra cost to the Owner. The use of coordination drawings is recommended but may not be required (refer to Division 1 for additional requirements). Lack of coordination drawings assumes contractor has verified and coordinated all work associated with installation.
- D. Obtain decision for approval from project Engineer for proposed grouped installations before proceeding, and for clearance in structure and finish of the building.
- E. Verify with drawings all ductwork and equipment layout in concealed areas.
- F. The Contractor to coordinate with, receive and install, Owner furnished equipment where indicated.
- G. Coordinate location of controls and instrumentation devices, including but not limited to control valves, control dampers, thermowells, pressure probes, flow switches, insertion flow meters, and ultrasonic flow meters, with Building Automation System (BAS) requirements.

### **1.9 DELIVERY, STORAGE, AND HANDLING**

- A. Delivery of Materials: Make provisions for delivery and safe storage of all materials. Check and properly receipt material to be "furnished by others" to contractor, and assume full responsibility for all materials while in storage with full visible identification and information.

### **1.10 PROJECT CONDITIONS**

- A. Existing Conditions: Field verify existing conditions that will determine exact locations, distances, levels, dimensions, elevations, etc. Review all drawings of other trades and report any conflicts to the Architect/Engineer which will affect the project cost. Lack of field verification does not constitute a basis for change orders and additional costs incurred by the owner or project. Contractor assumes full responsibility for completeness of installation including coordination of work with other trades.
- B. Existing facilities shall be considered occupied and functioning during the entire duration of construction. Care shall be taken when working in or around occupied spaces. There will be no interruption in mechanical systems or utilities without written approval from the Owner.

### **1.11 SUPPORTS**

- A. Mechanical Contractor is responsible for providing all support components necessary for properly supporting HVAC Systems including hangers, rods, anchors, steel, and bases.

## **PART 2 - PRODUCTS (not used)**

## **PART 3 - EXECUTION**

### **3.1 COMMON HVAC SYSTEMS INSTALLATION REQUIREMENTS**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of HVAC systems.
- B. Indicated locations and arrangements were used to size systems and address other design considerations. Install systems as indicated unless deviations to layout are approved by Architect and Engineer.

- C. Install systems in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install systems indicated to be exposed and in equipment rooms and service areas at right angles or parallel to building walls.
- E. Install equipment level and plumb, parallel and perpendicular to other building systems and components, unless otherwise indicated.
- F. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.
- G. Diagonal runs of piping and ductwork are prohibited unless specifically indicated otherwise.
- H. Install systems above accessible ceilings to allow sufficient space for ceiling panel removal.
- I. Install systems and equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations
- J. Install equipment with all required manufacturer's service clearances maintained.
- K. Install systems at indicated slopes.
- L. Install systems free of sags and bends.
- M. Install fittings for changes in direction and branch connections.
- N. Install systems to allow application of insulation.
- O. Select system components with pressure rating equal to or greater than system operating pressure.
- P. Install escutcheons for penetrations of walls, ceilings, and floors.
- Q. Running pipe and ductwork over electrical equipment and in elevator machine rooms is prohibited.
- R. Running piping and ductwork into or through interior exit stairways, other than systems serving such stairwells as permitted by the International Building Code, is prohibited.
- S. Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe and duct penetrations. Such Penetrations shall be sealed with firestop materials and required fire and smoke rated dampers shall be provided.
- T. Install HVAC systems on required supports and bases meeting maximum allowable spans and sized for the specific loads.
- U. Install controls and instrumentation devices for HVAC systems required for system operations and as indicated.

**END OF SECTION 230100**

## **SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Each motor and all components shall be designed, manufactured and tested in accordance with the following latest applicable standards.
  - 1. 2023 National Electrical Code.
  - 2. National Electric Manufacturers Association Standards (NEMA).
  - 3. ANSI/NEMA MG1 – Motors and Generators.
  - 4. IEEE-112 – Test Method “B”.
  - 5. NEMA – ICS-3-303.
  - 6. IEEE Standard 519.
  - 7. IEEE Standard 444 (ANSI C34.3).

#### **1.2 SUMMARY**

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.
- B. Furnish and install electric motors required for equipment furnished under this Division. Electric motors shall be factory mounted on equipment wherever possible and shall be constructed as specified in this Section. If electric motors are shipped loose and must be installed by the Division 26 Electrical Subcontractor, The Division 23 Subcontractor shall notify each Electrical Subcontractor in writing prior to the bid date.

#### **1.3 COORDINATION**

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
  - 1. Motor controllers.
  - 2. Torque, speed, and horsepower requirements of the load.
  - 3. Ratings and characteristics of supply circuit and required control sequence.
  - 4. Ambient and environmental conditions of installation location.

#### **1.4 SUBMITTALS**

- A. The following submittal data shall be furnished and shall include, but not limited to the following:
  - 1. Motors – For all motors not included in another section, Submittal shall state motor manufacturer, horsepower, frame size, frequency, voltage power factor, efficiency, speed starting torque class, insulation class, service factor and winding material. Also to be included, special shaft or mounting detail requirements as well as shaft limitation details and any other special requirements shall be listed on the drawings.

#### **1.5 WARRANTY**

- A. Furnish a warranty of (1) year.

### **PART 2 - PRODUCTS**

#### **2.1 GENERAL MOTOR REQUIREMENTS**

- A. Comply with NEMA MG 1 unless otherwise indicated.
- B. Comply with IEEE 841 for severe-duty motors.

## 2.2 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:
1. General Electric.
  2. Baldor.
  3. Marathon.
  4. Westinghouse.
  5. Siemens.
  6. Toshiba.

## 2.3 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 104 deg F and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
- C. All motors shall be started across the line, unless otherwise specified. All motors 100 horsepower and larger shall be suitable for wye-delta starting unless otherwise specified.
- D. Unless otherwise indicated, all motors shall be single speed (1,750 rpm). All motors shall include open drip proof enclosures unless otherwise specified. All motors installed outdoors and exposed to the elements shall be totally enclosed fan cooled (TEFC) or totally enclosed air over (TEAO).
1. Totally enclosed fan cooled (TEFC) motors shall have corrosion resistant fans.

Motor Voltages shall be as follows, unless otherwise noted on drawings and coordinated with Electrical design documents:

MOTOR HP	VOLTAGE
1/2 HP or Less	120V / Single Phase / 60 Hz.
Greater than 1/2 HP	208V / 3 Phase / 60 Hz.

- E. All motors shall have copper windings.

## 2.4 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Premium efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Windings shall be copper for all motors and treated with an epoxy varnish to inhibit the absorption of moisture.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading. Provide the necessary seals on the shaft to keep bearing system free of contaminants and moisture. Lubricant shall be high temperature, non-bleeding grease.
- H. Temperature Rise: Match insulation rating, unless otherwise noted.

- I. Insulation: Shall be Class F, 105°F rise insulation suitable for use in a 104°F ambient temperature.
- J. Code Letter Designation:
  - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
  - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

## **2.5 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS**

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
  - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
  - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
  - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
  - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
- C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

## **2.6 SINGLE-PHASE MOTORS**

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
  - 1. Permanent-split capacitor.
  - 2. Split phase.
  - 3. Capacitor start, inductor run.
  - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Pre-lubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Motor installation shall be in accordance with the manufacturer's recommendations and as indicated on the drawings. Align pulleys and install all belts at proper tension to minimize wear on belts and drives.

**END OF SECTION 230513**

**SECTION 230516 - EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Pipe loops and swing connections.
  - 2. Alignment guides and anchors.

**1.3 PERFORMANCE REQUIREMENTS**

- A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.
- B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Design Performance-Based Submittal: For each anchor and alignment guide indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation. This to include Seismic Support & Bracing which is applicable to this project.
  - 1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
  - 2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
  - 3. Alignment Guide Details: Detail field assembly and attachment to building structure.
  - 4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

**1.5 INFORMATIONAL SUBMITTALS**

- A. Welding certificates.
- B. Product Certificates: For each type of expansion joint, from manufacturer.

**1.6 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For expansion joints to include in maintenance manuals.

**1.7 QUALITY ASSURANCE**

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

2. ASME Boiler and Pressure Vessel Code: Section IX.

## PART 2 - PRODUCTS

### 2.1 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Adscos Manufacturing LLC.
  - b. Advanced Thermal Systems, Inc.
  - c. Flex-Hose Co., Inc.
  - d. Flex-Weld, Inc.
  - e. Flexicraft Industries.
  - f. Hyspan Precision Products, Inc.
  - g. Mason Industries, Inc.
  - h. Metraflex Company (The).
  - i. Senior Flexonics Pathway.
  - j. U.S. Bellows, Inc.
  - k. Unisource Manufacturing, Inc.
2. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to pipe.

B. Anchor Materials:

1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
  - a. Stud: Threaded, zinc-coated carbon steel.
  - b. Expansion Plug: Zinc-coated steel.
  - c. Washer and Nut: Zinc-coated steel.
5. Chemical Fasteners: Insert-type-stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.
  - a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
  - b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud unless otherwise indicated.
  - c. Washer and Nut: Zinc-coated steel.

## PART 3 - EXECUTION

### 3.1 PIPE LOOP AND SWING CONNECTION INSTALLATION

- A. Connect risers and branch connections to mains with at least (5) pipe fittings including tee in main.
- B. Connect risers and branch connections to terminal units with at least (4) pipe fittings including tee in riser.
- C. Connect mains and branch connections to terminal units with at least (4) pipe fittings including tee in main.

### 3.2 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

- A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.



- B. Install (2) guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than (4) pipe diameters from expansion joint.
- C. Attach guides to pipe and secure guides to building structure.
- D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- E. Anchor Attachments:
  - 1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
  - 2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24, U-bolts bolted to anchor.
- F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.
  - 1. Anchor Attachment to Steel Structural Members: Attach by welding.
  - 2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.
- G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

**END OF SECTION 230516\_**

## **SECTION 230517 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Sleeves.
  - 2. Stack-sleeve fittings.
  - 3. Sleeve-seal systems.
  - 4. Sleeve-seal fittings.
  - 5. Grout.

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.

### **PART 2 - PRODUCTS**

#### **2.1 SLEEVES**

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

#### **2.2 STACK-SLEEVE FITTINGS**

- A. Manufacturers: Subject to compliance with requirements.
- B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.
  - 1. Underdeck Clamp: Clamping ring with setscrews.

#### **2.3 SLEEVE-SEAL SYSTEMS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Advance Products & Systems, Inc.
  - 2. CALPICO, Inc.
  - 3. Metraflex Company (The).
  - 4. Pipeline Seal and Insulator, Inc.
  - 5. Proco Products, Inc.
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Stainless steel.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

## **2.4 SLEEVE-SEAL FITTINGS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Presealed Systems.
- B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

## **2.5 GROUT**

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Non-shrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

# **PART 3 - EXECUTION**

## **3.1 SLEEVE INSTALLATION**

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
  2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
1. Cut sleeves to length for mounting flush with both surfaces.
  2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 7 Section "Joint Sealants."
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 7 Section "Penetration Firestopping."

## **3.2 STACK-SLEEVE-FITTING INSTALLATION**

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using grout, seal the space around outside of stack-sleeve fittings.

- B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 7 Section "Penetration Firestopping."

### **3.3 SLEEVE-SEAL-SYSTEM INSTALLATION**

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

### **3.4 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.

### **3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE**

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
1. Exterior Concrete Walls above Grade:
    - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
    - b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves.
  2. Exterior Concrete Walls below Grade:
    - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
    - b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  3. Concrete Slabs-on-Grade:
    - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves with sleeve-seal system.

- 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
- b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves with sleeve-seal system.
  - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
4. Concrete Slabs above Grade:
  - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
  - b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves.
5. Interior Partitions:
  - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
  - b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

**END OF SECTION 230517**

## **SECTION 230518 - ESCUTCHEONS FOR HVAC PIPING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Escutcheons.
  - 2. Floor plates.

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.

### **PART 2 - PRODUCTS**

#### **2.1 ESCUTCHEONS**

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated and rough-brass finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.
- D. Split-Casting Brass Type: With polished, chrome-plated and rough-brass finish and with concealed hinge and setscrew.
- E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, [concealed] [and] [exposed-rivet] hinge, and spring-clip fasteners.

#### **2.2 FLOOR PLATES**

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- B. Split-Casting Floor Plates: Cast brass with concealed hinge.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
  - 1. Escutcheons for New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Chrome-Plated Piping: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
    - c. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.

- d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
  - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
  - f. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
  - g. Bare Piping in Equipment Rooms: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
- 2. Escutcheons for Existing Piping:
  - a. Chrome-Plated Piping: Split-casting brass type with polished, chrome-plated finish.
  - b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge.
  - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
  - d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
  - e. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed exposed-rivet hinge.
  - f. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
  - 1. New Piping: One-piece, floor-plate type.
  - 2. Existing Piping: Split-casting, floor-plate type.

### **3.2 FIELD QUALITY CONTROL**

- A. Replace broken and damaged escutcheons and floor plates using new materials.

**END OF SECTION 230518**

**SECTION 230519 - METERS AND GAGES FOR HVAC PIPING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Thermometers.
  - 2. Thermowells.
  - 3. Pressure gages.
  - 4. Gage attachments.
  - 5. Test plugs.
  - 6. Test-plug kits.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Wiring Diagrams: For power, signal, and control wiring.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Product Certificates: For each type of meter and gage, from manufacturer.

**1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

**PART 2 - PRODUCTS**

**2.1 LIQUID-IN-GLASS THERMOMETERS**

- A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Miljoco Corporation.
    - b. Palmer Wahl Instrumentation Group.
    - c. Tel-Tru Manufacturing Company.
    - d. Trerice, H. O. Co.
    - e. Weiss Instruments, Inc.
    - f. Winters Instruments - U.S.
  - 2. Standard: ASME B40.200.
  - 3. Case: Cast aluminum; 9-inch nominal size unless otherwise indicated.
  - 4. Case Form: Adjustable angle unless otherwise indicated.
  - 5. Tube: Glass with magnifying lens and red organic liquid.
  - 6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
  - 7. Window: Glass.
  - 8. Stem: Aluminum and of length to suit installation.
    - a. Design for Air-Duct Installation: With ventilated shroud.
    - b. Design for Thermowell Installation: Bare stem.
  - 9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
  - 10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.



**2.2 DUCT-THERMOMETER MOUNTING BRACKETS**

- A. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

**2.3 THERMOWELLS**

- A. Thermowells:
1. Standard: ASME B40.200.
  2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
  3. Material for Use with Copper Tubing: CNR.
  4. Material for Use with Steel Piping: CRES.
  5. Type: Stepped shank unless straight or tapered shank is indicated.
  6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
  7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
  8. Bore: Diameter required to match thermometer bulb or stem.
  9. Insertion Length: Length required to match thermometer bulb or stem.
  10. Lagging Extension: Include on thermowells for insulated piping and tubing.
  11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
- B. Heat-Transfer Medium: Mixture of graphite and glycerin.

**2.4 PRESSURE GAGES**

- A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. AMETEK, Inc.; U.S. Gauge.
    - b. Ashcroft Inc.
    - c. Ernst Flow Industries.
    - d. Flo Fab Inc.
    - e. Marsh Bellofram.
    - f. Miljoco Corporation.
    - g. Noshok.
    - h. Palmer Wahl Instrumentation Group.
    - i. REOTEMP Instrument Corporation.
    - j. Tel-Tru Manufacturing Company.
    - k. Trerice, H. O. Co.
    - l. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
    - m. Weiss Instruments, Inc.
    - n. WIKA Instrument Corporation - USA.
    - o. Winters Instruments - U.S.
  2. Standard: ASME B40.100.
  3. Case: Liquid-filled type; cast aluminum or drawn steel; 6-inch nominal diameter.
  4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
  5. Pressure Connection: Brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
  6. Movement: Mechanical, with link to pressure element and connection to pointer.
  7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
  8. Pointer: Dark-colored metal.
  9. Window: Glass.
  10. Ring: Brass.
  11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

**2.5 GAGE ATTACHMENTS**

- A. Snubbers: ASME B40.100, brass; with NPS 1/4, ASME B1.20.1 pipe threads and porous-metal-type surge-dampening device. Include extension for use on insulated piping.
- B. Siphons: Loop-shaped section of brass NPS 1/4 pipe threads.
- C. Valves: Brass ball, with NPS 1/4, ASME B1.20.1 pipe threads.

**2.6 TEST PLUGS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Flow Design, Inc.
  - 2. Miljoco Corporation.
  - 3. National Meter, Inc.
  - 4. Peterson Equipment Co., Inc.
  - 5. Sisco Manufacturing Company, Inc.
  - 6. Trerice, H. O. Co.
  - 7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
  - 8. Weiss Instruments, Inc.
- B. Description: Test-station fitting made for insertion into piping tee fitting.
- C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- D. Thread Size: NPS 1/4, ASME B1.20.1 pipe thread.
- E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- F. Core Inserts: EPDM self-sealing rubber.

**2.7 TEST-PLUG KITS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Flow Design, Inc.
  - 2. Miljoco Corporation.
  - 3. National Meter, Inc.
  - 4. Peterson Equipment Co., Inc.
  - 5. Sisco Manufacturing Company, Inc.
  - 6. Trerice, H. O. Co.
  - 7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
  - 8. Weiss Instruments, Inc.
- B. Furnish (2) test-plug kits each containing (2) thermometers, (1) pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.
- C. Low-Range Thermometer: Small, bimetallic insertion type with 2-inch-diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F
- D. High-Range Thermometer: Small, bimetallic insertion type with 2-inch-diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F.
- E. Pressure Gage: Small, Bourdon-tube insertion type with 3-inch-diameter dial and probe. Dial range shall be at least 0 to 200 psig.
- F. Carrying Case: Metal or plastic, with formed instrument padding.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.

- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.
- G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- H. Install valve and snubber in piping for each pressure gage for fluids (except steam).
- I. Install valve and syphon fitting in piping for each pressure gage for steam.
- J. Install test plugs in piping tees.
- K. Install flow indicators in piping systems in accessible positions for easy viewing.
- L. Install permanent indicators on walls or brackets in accessible and readable positions.
- M. Install connection fittings in accessible locations for attachment to portable indicators.
- N. Install thermometers in the following locations:
  - 1. Inlet and outlet of each hydronic zone.
  - 2. Inlet and outlet of each hydronic coil in air-handling units.
  - 3. Two inlets and two outlets of each hydronic heat exchanger.
  - 4. Hydronic inlet and outlet of each steam heat exchanger.
  - 5. Outside-, return-, supply-, and mixed-air ducts.
- O. Install pressure gages in the following locations:
  - 1. Discharge of each pressure-reducing valve.
  - 2. Inlet and outlet of each chilled-water connection.
  - 3. Suction and discharge of each pump.
  - 4. Two inlets and two outlets of each hydronic heat exchanger.
  - 5. Hydronic inlet and outlet of each steam heat exchanger.

### **3.2 CONNECTIONS**

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

### **3.3 ADJUSTING**

- A. After installation, calibrate meters according to manufacturer's written instructions.
- B. Adjust faces of meters and gages to proper angle for best visibility.

### **3.4 THERMOMETER SCHEDULE**

- A. Thermometers at inlet and outlet of each hydronic coil in air-handling units and built-up central systems:
  - 1. Industrial-style, liquid-in-glass type.
- B. Thermometers at inlet and outlet of each terminal unit hydronic coil (VAV boxes, cabinet unit heaters, unit heaters, fin tube radiation):
  - 1. Test plug with EPDM self-sealing rubber inserts.
- C. Thermometers at inlets and outlets of each hydronic heat exchanger

- 1. Industrial-style, liquid-in-glass type.
- D. Thermometers at hydronic inlets and outlets of each steam heat exchanger
  - 1. Industrial-style, liquid-in-glass type.
- E. Thermometers at outside-, return-, supply-, and mixed-air ducts:
  - 1. Industrial-style, liquid-in-glass type.
- F. Thermometer stems shall be of length to match thermowell insertion length.

### **3.5 THERMOMETER SCALE-RANGE SCHEDULE**

- A. Scale Range for Chilled-Water Piping: 0 to 100 deg F.
- B. Scale Range for Heating, Hot-Water Piping: 0 to 250 deg F.
- C. Scale Range for Steam and Steam-Condensate Piping: 0 to 250 deg F (0 to 150 deg C).
- D. Scale Range for Air Ducts: 0 to 150 deg F.

### **3.6 PRESSURE-GAGE SCHEDULE**

- A. Pressure gages at discharge of each pressure-reducing valve shall be the following:
  - 1. Liquid-filled, direct-mounted, metal case.
- B. Pressure gages at inlet and outlet of each chilled-water connection shall be the following:
  - 1. Liquid-filled, direct-mounted, metal case.
- C. Pressure gages at suction and discharge of each pump shall be the following:
  - 1. Liquid-filled, direct-mounted, metal case.
- D. Pressure gages at inlet and outlet of each Air Handling Unit hydronic coil:
  - 1. Liquid-filled, direct-mounted, metal case.
- E. Pressure gages at inlets and outlets of each hydronic heat exchanger
  - 1. Liquid-filled, direct-mounted, metal case.
- F. Pressure gages at hydronic inlets and outlets of each steam heat exchanger
  - 1. Liquid-filled, direct-mounted, metal case.
- G. Pressure gages at steam inlet of each steam heat exchanger
  - 1. Liquid-filled, direct-mounted, metal case.
- H. Pressure gages at inlet and outlet of each terminal unit hydronic coil (VAV boxes, cabinet unit heaters, unit heaters, fin tube radiation):
  - 1. Test plug with EPDM self-sealing rubber inserts.

### **3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE**

- A. Scale Range for Chilled-Water Piping: 0 to 160 psi.
- B. Scale Range for Heating, Hot-Water Piping: 0 to 160 psi.
- C. Scale Range for Steam Piping: 0 to 200 psi.

**END OF SECTION 230519**

**SECTION 230523 – GENERAL DUTY VALVES FOR HVAC PIPING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Bronze ball valves.
  - 2. High-performance butterfly valves.
  - 3. Bronze swing check valves.
  - 4. Iron swing check valves.
  - 5. Bronze globe valves.
  - 6. Iron globe valves.
  - 7. Lubricated plug valves.
  - 8. Eccentric plug valves.
  - 9. Chainwheels.
- B. Related Sections:
  - 1. Division 23 Section "Identification for HVAC Piping and Equipment" for valve tags and schedules.

**1.3 DEFINITIONS**

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of valve indicated.

**1.5 QUALITY ASSURANCE**

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
  - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.

2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

## **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Prepare valves for shipping as follows:
1. Protect internal parts against rust and corrosion.
  2. Protect threads, flange faces, grooves, and weld ends.
  3. Set globe valves closed to prevent rattling.
  4. Set ball and plug valves open to minimize exposure of functional surfaces.
  5. Set butterfly valves closed or slightly open.
  6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
1. Maintain valve end protection.
  2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL REQUIREMENTS FOR VALVES**

- A. Refer to HVAC valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
1. Gear Actuator: For quarter-turn valves NPS 6 and larger.
  2. Handwheel: For valves other than quarter-turn types.
  3. Handlever: For quarter-turn valves NPS 5 and smaller except plug valves.
  4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 5 plug valves, for each size square plug-valve head.
  5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
  2. Butterfly Valves: With extended neck.
- F. Valve-End Connections:
1. Flanged: With flanges according to ASME B16.1 for iron valves.
  2. Solder Joint: With sockets according to ASME B16.18.
- G. Valve Bypass and Drain Connections: MSS SP-45.

### **2.2 BRONZE BALL VALVES**

- A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Valve, Inc.
  - b. Conbraco Industries, Inc.; Apollo Valves.
  - c. Crane Co.; Crane Valve Group; Crane Valves.
  - d. Hammond Valve.
  - e. Lance Valves; a division of Advanced Thermal Systems, Inc.
  - f. Legend Valve.
  - g. Milwaukee Valve Company.
  - h. NIBCO INC.
  - i. Red-White Valve Corporation.
  - j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
  - a. Standard: MSS SP-110.
  - b. SWP Rating: 150 psig.
  - c. CWP Rating: 600 psig.
  - d. Body Design: Two piece.
  - e. Body Material: Bronze.
  - f. Ends: Threaded.
  - g. Seats: PTFE.
  - h. Stem: Stainless steel.
  - i. Ball: Stainless steel.
  - j. Port: Full.
  - k. Locking handle.

## 2.3 HIGH-PERFORMANCE BUTTERFLY VALVES

### A. Class 150, Single-Flange, High-Performance Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
  - b. Bray Controls; a division of Bray International.
  - c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
  - d. Crane Co.; Crane Valve Group; Flowseal.
  - e. Crane Co.; Crane Valve Group; Stockham Division.
  - f. DeZurik Water Controls.
  - g. Hammond Valve.
  - h. Jamesbury; a subsidiary of Metso Automation.
  - i. Keystone
  - j. Milwaukee Valve Company.
  - k. NIBCO INC.
  - l. Process Development & Control, Inc.
  - m. Tyco Valves & Controls; a unit of Tyco Flow Control.
  - n. Xomox Corporation.
2. Description:
  - a. Standard: MSS SP-68.
  - b. CWP Rating: 285 psig at 100 deg F.
  - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
  - d. Body Material: Ductile iron.
  - e. Seat: EPDM.
  - f. Stem: Stainless steel; offset from seat plane.
  - g. Disc: Stainless steel.
  - h. Service: Bidirectional.
  - i. Handle: Gear operators for valves NPS 6 and larger. Seven-position lever for valves NPS 5 and smaller.

## 2.4 BRONZE SWING CHECK VALVES

### A. Class 150, Bronze Swing Check Valves with Bronze Disc:



1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Valve, Inc.
  - b. Crane Co.; Crane Valve Group; Crane Valves.
  - c. Crane Co.; Crane Valve Group; Jenkins Valves.
  - d. Crane Co.; Crane Valve Group; Stockham Division.
  - e. Kitz Corporation.
  - f. Milwaukee Valve Company.
  - g. NIBCO INC.
  - h. Red-White Valve Corporation.
  - i. Zy-Tech Global Industries, Inc.
2. Description:
  - a. Standard: MSS SP-80, Type 3.
  - b. CWP Rating: 300 psig.
  - c. Body Design: Horizontal flow.
  - d. Body Material: ASTM B 62, bronze.
  - e. Ends: Threaded.
  - f. Disc: Bronze.

## **2.5 IRON SWING CHECK VALVES**

### **A. Class 125, Iron Swing Check Valves with Metal Seats:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Crane Co.; Crane Valve Group; Jenkins Valves.
  - c. Crane Co.; Crane Valve Group; Stockham Division.
  - d. Hammond Valve.
  - e. Kitz Corporation.
  - f. Legend Valve.
  - g. Milwaukee Valve Company.
  - h. NIBCO INC.
  - i. Powell Valves.
  - j. Red-White Valve Corporation.
  - k. Sure Flow Equipment Inc.
  - l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  - m. Zy-Tech Global Industries, Inc.
2. Description:
  - a. Standard: MSS SP-71, Type I.
  - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
  - c. NPS 14 to NPS 24, CWP Rating: 150 psig.
  - d. Body Design: Clear or full waterway.
  - e. Body Material: ASTM A 126, gray iron with bolted bonnet.
  - f. Ends: Flanged.
  - g. Trim: Bronze.
  - h. Gasket: Asbestos free.

## **2.6 BRONZE GLOBE VALVES**

### **A. Class 150, Bronze Globe Valves with Nonmetallic Disc:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Hammond Valve.
  - c. Kitz Corporation.
  - d. Milwaukee Valve Company.
  - e. NIBCO INC.
  - f. Powell Valves.
  - g. Red-White Valve Corporation.

- h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  - i. Zy-Tech Global Industries, Inc.
- 2. Description:
  - a. Standard: MSS SP-80, Type 2.
  - b. CWP Rating: 300 psig.
  - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
  - d. Ends: Threaded.
  - e. Stem: Bronze.
  - f. Disc: PTFE or TFE.
  - g. Packing: Asbestos free.
  - h. Handwheel: Malleable iron.

## 2.7 IRON GLOBE VALVES

### A. Class 125, Iron Globe Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Crane Co.; Crane Valve Group; Jenkins Valves.
  - c. Crane Co.; Crane Valve Group; Stockham Division.
  - d. Hammond Valve.
  - e. Kitz Corporation.
  - f. Milwaukee Valve Company.
  - g. NIBCO INC.
  - h. Powell Valves.
  - i. Red-White Valve Corporation.
  - j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  - k. Zy-Tech Global Industries, Inc.
- 2. Description:
  - a. Standard: MSS SP-85, Type I.
  - b. CWP Rating: 200 psig.
  - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
  - d. Ends: Flanged.
  - e. Trim: Bronze.
  - f. Packing and Gasket: Asbestos free.

## 2.8 LUBRICATED PLUG VALVES

### A. Class 125, Regular-Gland, Lubricated Plug Valves with Flanged Ends:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Nordstrom Valves, Inc.
  - b. The Kraissl Company
  - c. Flowserve Corp.
- 2. Description:
  - a. Standard: MSS SP-78, Type II.
  - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
  - c. NPS 14 to NPS 24, CWP Rating: 150 psig.
  - d. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
  - e. Pattern: Regular or short.
  - f. Plug: Cast iron or bronze with sealant groove.

## 2.9 ECCENTRIC PLUG VALVES

### A. 175 CWP, Eccentric Plug Valves with Resilient Seating.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Clow Valve Co.; a division of McWane, Inc.
  - b. DeZurik Water Controls.
  - c. Homestead Valve; a division of Olson Technologies, Inc.
  - d. M&H Valve Company; a division of McWane, Inc.
  - e. Milliken Valve Company.
  - f. Henry Pratt Company.
  - g. Val-Matic Valve & Manufacturing Corp.
2. Description:
- a. Standard: MSS SP-108.
  - b. CWP Rating: 175 psig minimum.
  - c. Body and Plug: ASTM A 48/A 48M, gray iron; ASTM A 126, gray iron; or ASTM A 536, ductile iron.
  - d. Bearings: Oil-impregnated bronze or stainless steel.
  - e. Ends: Flanged.
  - f. Stem-Seal Packing: Asbestos free.
  - g. Plug, Resilient-Seating Material: Suitable for potable-water service unless otherwise indicated.

## **2.10 CHAINWHEELS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Babbitt Steam Specialty Co.
  2. Roto Hammer Industries.
  3. Trumbull Industries.
- B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
  2. Attachment: For connection to ball, butterfly, and plug valve stems.
  3. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve. Include zinc coating.
  4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

### **3.2 VALVE INSTALLATION**

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for all valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.
- F. Install check valves for proper direction of flow and as follows:
  - 1. Swing Check Valves: In horizontal position with hinge pin level.
  - 2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
  - 3. Lift Check Valves: With stem upright and plumb.

### **3.3 ADJUSTING**

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

### **3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS**

- A. If valve applications are not indicated, use the following:
  - 1. Shutoff Service: Ball or butterfly valves. Do not use gate valves on this project.
  - 2. Dead-End Service: Single-flange (lug) type.
  - 3. Throttling Service: Globe valves.
  - 4. Pump-Discharge Check Valves:
    - a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
    - b. NPS 2-1/2 and Larger: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal-seat check valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
  - 1. For Copper Tubing, NPS 2 and Smaller: Flanged or solder ends.
  - 2. For Steel Piping, NPS 2 and Smaller: Flanged ends.
  - 3. For Steel Piping, NPS 2-1/2 and Larger: Flanged ends.

### **3.5 GEOTHERMAL (GLYCOL) WATER AND HOT WATER VALVE SCHEDULE**

- A. Pipe NPS 2 and Smaller:
  - 1. Ball Valves: Two piece, full port, bronze with stainless-steel trim.
  - 2. Bronze Swing Check Valves: Class 150, bronze disc.
  - 3. Bronze Globe Valves: Class 150, bronze disc.
- B. Pipe NPS 2-1/2 and Larger:
  - 1. High-Performance Butterfly Valves: Class 150, single flange.
  - 2. Iron Swing Check Valves: Class 125, metal seats.

3. Iron Globe Valves, NPS 2-1/2 to NPS 12: Class 125.
4. Lubricated Plug Valves: Class 125, threaded.

**3.6 COLD WATER MAKE-UP AND COLD CONDENSATE DRAIN SCHEDULE**

**A. Pipe NPS 2 and Smaller:**

1. Ball Valves: Two piece, full port, bronze with stainless-steel trim.
2. Bronze Swing Check Valves: Class 150, bronze disc.

**END OF SECTION 230523**

**SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Metal pipe hangers and supports.
  - 2. Trapeze pipe hangers.
  - 3. Metal framing systems.
  - 4. Thermal-hanger shield inserts.
  - 5. Fastener systems.
  - 6. Pipe stands.
  - 7. Equipment supports.
- B. Related Sections:
  - 1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
  - 2. Division 23 Section "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
  - 3. Division 23 Section "Vibration Controls for HVAC" for vibration isolation devices.
  - 4. Division 23 Section "Metal Ducts" for duct hangers and supports.

**1.3 DEFINITIONS**

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

**1.4 PERFORMANCE REQUIREMENTS**

- A. Design Performance-Based: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports. This to include Seismic support and bracing which is applicable to this Project.
- C. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
  - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
  - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

**1.5 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
  - 1. Trapeze pipe hangers.

2. Metal framing systems.
  3. Pipe stands.
  4. Equipment supports.
- C. Design Performance-Based Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Detail fabrication and assembly of trapeze hangers.
  2. Design Calculations: Calculate requirements for designing trapeze hangers.

## **1.6 INFORMATIONAL SUBMITTALS**

- A. Welding certificates.

## **1.7 QUALITY ASSURANCE**

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

## **PART 2 - PRODUCTS**

### **2.1 METAL PIPE HANGERS AND SUPPORTS**

- A. Carbon-Steel Pipe Hangers and Supports:
1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
  3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
  4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- B. Stainless-Steel Pipe Hangers and Supports:
1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
- C. Copper Pipe Hangers:
1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
  2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

### **2.2 TRAPEZE PIPE HANGERS**

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

### **2.3 METAL FRAMING SYSTEMS**

- A. MFMA Manufacturer Metal Framing Systems:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Allied Tube & Conduit.
    - b. Cooper B-Line, Inc.
    - c. Flex-Strut Inc.
    - d. GS Metals Corp.
    - e. Thomas & Betts Corporation.
    - f. Unistrut Corporation; Tyco International, Ltd.
    - g. Wesanco, Inc.
  2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
  3. Standard: MFMA-4.
  4. Channels: Continuous slotted steel channel with upturned lips.
  5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
  6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
  7. Metallic Coating: Hot-dipped galvanized.
- B. Non-MFMA Manufacturer Metal Framing Systems:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Anvil International; a subsidiary of Mueller Water Products Inc.
    - b. Empire Industries, Inc.
    - c. ERICO International Corporation.
    - d. Haydon Corporation; H-Strut Division.
    - e. NIBCO INC.
    - f. PHD Manufacturing, Inc.
    - g. PHS Industries, Inc.
  2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
  3. Standard: Comply with MFMA-4.
  4. Channels: Continuous slotted steel channel with upturned lips.
  5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
  6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
  7. Coating: Zinc.

## **2.4 THERMAL-HANGER SHIELD INSERTS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Carpenter & Paterson, Inc.
  2. Clement Support Services.
  3. ERICO International Corporation.
  4. National Pipe Hanger Corporation.
  5. PHS Industries, Inc.
  6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
  7. Piping Technology & Products, Inc.
  8. Rilco Manufacturing Co., Inc.
  9. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Cold Piping: C 59, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.



- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

## **2.5 FASTENER SYSTEMS**

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

## **2.6 PIPE STANDS**

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.
- D. High-Type, Single-Pipe Stand:
1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
  2. Base: Stainless steel.
  3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
  4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand:
1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
  2. Bases: One or more; plastic.
  3. Vertical Members: Two or more protective-coated-steel channels.
  4. Horizontal Member: Protective-coated-steel channel.
  5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

## **2.7 EQUIPMENT SUPPORTS**

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

## **2.8 MISCELLANEOUS MATERIALS**

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
1. Properties: Nonstaining, noncorrosive, and nongaseous.
  2. Design Mix: 5000-psi, 28-day compressive strength.

### **PART 3 - EXECUTION**

#### **3.1 HANGER AND SUPPORT INSTALLATION**

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
  - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
  - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
  - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Pipe Stand Installation:
  - 1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
  - 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Division 07 Section "Roof Accessories" for curbs.
- G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- J. Install lateral bracing with pipe hangers and supports to prevent swaying.
- K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- L. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- N. Insulated Piping:

1. Attach clamps and spacers to piping.
  - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
  - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
  - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
  - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
  - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
  - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
  - b. NPS 4: 12 inches long and 0.06 inch thick.
  - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
  - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
  - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### **3.2 EQUIPMENT SUPPORTS**

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### **3.3 METAL FABRICATIONS**

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
  1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
  4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

**3.4 ADJUSTING**

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

**3.5 PAINTING**

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 Section "Exterior Painting" Division 09 Section "Interior Painting" and Division 09 Section "High Performance Coatings."
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

**3.6 HANGER AND SUPPORT SCHEDULE**

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers, and metal framing systems and attachments for general service applications.
- F. Use stainless-steel pipe hangers and stainless-steel attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
  - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
  - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
  - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
  - 5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.

6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
  7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
  11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
  12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
  13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
  15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
  16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
  17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
  18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
  19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
  20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
  21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
  4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.

3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
  12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
  13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
  2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
  3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
  4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
  5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
  6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
  7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
  8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
    - a. Horizontal (MSS Type 54): Mounted horizontally.
    - b. Vertical (MSS Type 55): Mounted vertically.
    - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

- Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

**END OF SECTION 230529**

**SECTION 230548 - VIBRATION CONTROLS FOR HVAC**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. The Division 23 Subcontractor shall assume complete responsibility for the anchoring of the equipment, piping systems, etc., specified herein to the concrete foundation pads, to the concrete inertia bases and to the supporting structural steel and concrete beams.
- B. Furnish and install foundation vibration isolation and associated equipment for piping, rotating equipment, etc., as specified herein.
- C. This section Includes the following:
  - 1. All outdoor equipment, including roof-mounted components, shall comply with requirement for Wind Load, and State Building Code. There shall be no decrease of the effects of wind load on a component due to other structures or components acting as blocks or screens.
  - 2. All below, at grade or above grade locations located in a flood hazard area as defined and located herein.
  - 3. Wind and flood load and isolation materials shall be the certified products of the same manufacturing group and shall be certified by that group.
  - 4. It is the intent of the wind load portion of this specification to keep all mechanical, building system components in place during high wind event and additionally operational.
  - 5. All such systems must be installed in strict accordance with wind codes, component manufacturer's and building construction standards.
  - 6. This specification is considered to be minimum requirements for, wind, flood and vibration control considerations.
  - 7. Any variation, which results in non-compliance with the specification requirements, shall be corrected by the contractor in an approved manner.
- D. The Division 23 Contractor shall provide all miscellaneous steel for support of equipment, piping and ductwork systems.
- E. Section Includes:
  - 1. Elastomeric isolation pads.
  - 2. Elastomeric isolation mounts.
  - 3. Restrained elastomeric isolation mounts.
  - 4. Open-spring isolators.
  - 5. Housed-spring isolators.
  - 6. Restrained-spring isolators.
  - 7. Housed-restrained-spring isolators.
  - 8. Pipe-riser resilient supports.
  - 9. Resilient pipe guides.
  - 10. Air-spring isolators.
  - 11. Restrained-air-spring isolators.
  - 12. Elastomeric hangers.
  - 13. Spring hangers.
  - 14. Vibration isolation equipment bases.
  - 15. Restrained isolation roof-curb rails.
- F. Related Requirements:
  - 1. All equipment and material to be furnished and installed on this project shall be in accordance with the requirements of the authorities having jurisdiction and suitable for its intended use on.



2. All vibration isolation devices and components shall be designed, manufactured, and tested in accordance with the latest applicable standards.

### 1.3 DEFINITIONS

- A. Basic Wind Speed: The basic wind speed, in mph, for determination of the wind loads shall be as per State Building Code, or local code, if more severe. Local jurisdictions shall determine wind speeds for indicated special wind regions located near gorges or mountainous terrain. Section 6.5.4 of ASCE 7-05 shall be used after determination of basic wind speed by the local jurisdiction. See Section 1609.3 ASCE 7-05 for basic wind speed determination in non-hurricane prone regions.
- B. Flood or Flooding: A general and temporary condition or partial and complete inundation of normally dry land from:
  1. The overflow of inland or tidal waters.
  2. The unusual and rapid accumulation of runoff of surface waters from any source.
- C. Flood Hazard Area: The greater of the following of two areas:
  1. The area within a flood plain subject to a 1 percent or greater chance of flooding in any year.
  2. The area designated as a flood hazard area on a community's flood hazard map, or otherwise legally designated.
- D. Special Flood Hazard Area Subject to High Velocity Wave Action: Area within the flood hazard area that is subject to high velocity wave action and shown on a Flood Insurance Rate Map (FIRM) or other flood hazard map as zone V, VO, VE or VI-30.
- E. Flood Insurance Rate Map (FIRM): An official map of a community on which the Federal Emergency Management Agency (FEMA) has delineated both the special flood hazard areas and the risk premium zones applicable to the community.
- F. Hurricane Prone Regions: Areas prone to hurricanes include the U.S. Atlantic Ocean, Gulf Coasts, Hawaii, Puerto Rico, Guam, Virgin Islands, and American Samoa where the wind speed is greater than 90 mph.

### 1.4 GENERAL DESIGN AND PERFORMANCE

- A. General Design Requirements.
  1. WIND CONSIDERATIONS: This project has wind design requirements as follows:
    - a. Wind load in hurricane, tornado and/or wind-borne debris regions (90 plus mph) having a building height greater than 60 feet. Rooftop structures; Section 6.5.15.1 of ASCE 7-05 design requirements apply)
    - b. See structural drawings and specifications for project wind classification data, copied here for reference only:
      - 1) Ultimate Design Wind Speed: 129 MPH
  2. SEISMIC CONSIDERATIONS: This project has design requirements as follows:
    - a. Seismic restraints are required for ALL Division 23 HVAC work.
      - a. For each seismic-restraint device, including **seismic-restrained mounting, pipe-riser resilient support, snubber, seismic restraint, seismic-restraint accessory, concrete anchor and insert**, that is required by this Section or is indicated on Drawings, submit the following:
      - b. Seismic Restraint, and Vibration Isolation Base Selection: Select vibration isolators, seismic restraints, and vibration isolation bases complying with performance requirements, design criteria, and analysis data.
      - c. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification by professional engineer that riser system was examined for excessive stress and that none exists.

- d. Concrete Anchors and Inserts: Include calculations showing anticipated seismic and wind loads. Include certification that device is approved by an NRTL for seismic reinforcement use.
  - e. Seismic Design Calculations: Submit all input data and loading calculations prepared under "Seismic Design Calculations" Paragraph in "Performance Requirements" Article.
- B. General Design Performance Requirements
- 1. Attachment calculations by the Restraint Manufacturer's licensed Engineer substantiating the mounting system or wind restraints, fasteners or ICC Certified Concrete Anchors shall be submitted for approval along with the shop drawings. Wind loads shall have their calculations based on Section 1.4, Paragraph B, article 8, Design Wind Loads. A registered professional engineer having a PE from the same state as the project, or state of restraint manufacturer shall stamp all analysis, or as required by local building codes.
  - 2. Design Wind Loads:
    - a. All outdoor mounted components shall be positively fastened to their supporting structure as discussed below. Fastening to metal deck is unacceptable.
      - 1) If component is curb mounted, article 7, Design Seismic Loads, paragraph g shall be followed for all roof-mounted components in excess of 9 sq. ft. in cross-sectional area. Curbs shall be as described in Base type B-3 if isolated, Base type B-4 if non-isolated.
      - 2) If component is support mounted, article 7, Design Seismic Loads, paragraph g shall be followed for all roof-mounted components requiring waterproofed rail supports. Equipment supports shall be Base type B-5 if isolated, Base type B-6 if non-isolated.
      - 3) If equipment is dunnage mounted, positive attachment shall occur through welding or bolting of equipment to dunnage steel.
    - b. Loads and calculations shall be based on State Building Code and related sections in ASCE 7-05.
    - c. Where buildings are less than or equal to 60 feet in height to the top of the roof slab (not parapet walls), the force on roof-mounted components shall be based on Section 6.5.15.1, ASCE 7-05.
    - d. Equivalent basic wind speed shall be based on State Building Code.  
In no event shall adjacent buildings, structures or screens be considered to diminish the calculated wind load or its effect on an outdoor component.

## 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
  - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device type required.
- B. Shop Drawings:
- 1. The Mechanical Subcontractor shall submit isolation Shop Drawings for all horizontal and vertical piping, equipment inertia bases, mechanical equipment and cooling towers to the Structural Engineer, Architect and Mechanical Engineer prior to fabrication and installation of any of the isolation and restraint equipment of systems.
  - 2. Submittal data shall include certification by the vibration isolation manufacturer that all heating hot water and steam piping systems for both horizontal and vertical piping have been examined for excessive stresses and that none will exist in the proposed design.
  - 3. Piping shop drawings shall indicate the anticipated expansion and contraction of all piping systems at each support point, initial and final loads on the building structure, spring deflection changes, construction loading, normal operating condition loading and the structural loading, which will occur during expansion and contraction.
  - 4. Each device shall have a permanently attached identification tag which is cross referenced to the diagrams by location and service.
  - 5. Detail fabrication and assembly of equipment bases shall include anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
  - 6. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
- C. Design Performance-Based Submittal: For each vibration isolation device.

1. Include design calculations for selecting vibration isolators and for designing vibration isolation bases.

## **1.6 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Show coordination of vibration isolation device installation for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.
- B. Qualification Data: For testing agency.
- C. Welding certificates.

## **1.7 QUALITY ASSURANCE**

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

## **PART 2 - PRODUCTS**

### **2.1 VIBRATION ISOLATION**

- A. Springs: All springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. All springs except internal nested springs shall have an outside diameter not less than 0.8 of the compressed height of the spring. Ends of springs shall be square and ground for stability. Laterally stable springs shall have  $k_x/k_y$  ratios of at least 0.9. All springs shall be fully color-coded to indicate capacity – color striping is not considered adequate.
- B. Corrosion Protection: All springs shall be powder-coated enamel. Housings shall be galvanized, powder-coated enamel, or painted with rust-resistant paint. Hot-dipped galvanized housings shall be provided as indicated on the Schedule.

### **2.2 MANUFACTURERS**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Mason Industries, Inc.
  - b. Kinetics Noise Control, Inc.
  - c. Vibration Eliminator Co., Inc.
  - d. Vibration Mountings & Controls, Inc.

### **2.3 ELASTOMERIC ISOLATION PADS**

- A. Elastomeric Isolation Pads - Type A:
  1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
  2. Size: Factory or field cut to match requirements of supported equipment.
  3. Pad Material: Neoprene.
  4. Surface Pattern: Waffle pattern..
  5. Load-bearing metal plates adhered to pads.
  6. 0.75" minimum thickness.
  7. 50 PSI maximum loading.
  8. 1/16" galvanized steel plate between multiple layers of pad thickness.
  9. Through Hole with Resilient washer.
  10. Elastomeric Isolation Pads shall be Mason Type Super W or approved equal.
- B. Elastomeric Isolation Mount – Type D
  1. Molded unit type neoprene element with projecting bushing lining rod clearance hole.
  2. Neoprene element to be minimum 1 3/4" (45 mm) thick.
  3. Steel retainer box encasing neoprene mounting.
  4. Clearance between mounting hanger rod and neoprene bushing shall be minimum 1/8" .
  5. Mountings shall be Mason Industries Type HD or approved equal.

## **2.4 OPEN-SPRING ISOLATORS - Type E**

- A. Open Spring Isolators:
1. Spring isolators shall be free standing and laterally stable without any housing and complete with a molded neoprene cup or 1/4"(6mm) neoprene acoustical friction pad between the baseplate and the support.
  2. All mountings shall have leveling bolts that must be rigidly bolted to the equipment.
  3. Installed and operating heights shall be equal.
  4. The ratio of the spring diameter divided by the compressed spring height shall be no less than 0.8. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection.
  5. All air ducts with a cross section of 2ft<sup>2</sup> or larger shall be isolated from the building structure by Type C floor supports with a minimum deflection of 0.75". Isolators shall continue for 50' from the equipment.
  6. Submittals shall include spring diameters, deflection, compressed spring height and solid spring height.
  7. Mountings shall be Mason type SLF, or approved equal.

## **2.5 RESTRAINED-SPRING ISOLATORS**

- A. Restrained spring isolators - Type F
1. Spring isolators shall be free standing and laterally stable without any housing and complete with a molded neoprene cup or 1/4"(6mm) neoprene acoustical friction pad between the baseplate and the support.
  2. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Installed and operating heights shall be equal.
  3. Neoprene acoustical pad within a rigid sided housing that includes vertical limit stops to prevent spring extension when weight is removed and temporary steel spacers between the upper and lower housings.
  4. Housings shall serve as blocking during erection. When the equipment is at full operating weight, the springs shall be adjusted to assume the weight and the spacers removed, without changing the installed and operating heights. All restraining bolts shall have large rubber grommets to provide cushioning in the vertical as well as horizontal modes.
  5. The hole through the bushing shall be a minimum of 0.75"(20mm) larger in diameter than the restraining bolt.
  6. Horizontal clearance on the sides between the spring assembly and the housing shall be a minimum of 0.5"(12mm) to avoid bumping and interfering with the spring action.
  7. Vertical limit stops shall be out of contact during normal operation.
  8. Cooling tower mounts are to be located between the supporting steel and the roof or the grillage and dunnage as shown on the drawings when there is no provision for direct mounting.
  9. Housings and springs shall be powder coated and hardware electro galvanized.
  10. The ratio of the spring diameter divided by the compressed spring height shall be no less than 0.8. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection.
  11. Submittals shall include spring diameters, deflection, compressed spring height and solid spring height.
  12. Mountings shall be Mason Industries Type SLR, or approved equal..

## **2.6 PIPE-RISER RESILIENT SUPPORT**

- A. Description: All-directional, acoustical pipe anchor consisting of Anchors, Guides and spring mounts – Type H.
1. All vertical risers subjected to thermal expansion and/or contraction shall be supported by spring isolators and central anchors designed to insure loading within design limits at structural support points.
  2. The riser design must be prepared and submitted for approval by the same isolation vendor supplying the HVAC mechanical equipment isolation and must include the initial load, initial deflection, change in deflection, final load and change in load at all spring support locations. In order to minimize load changes, the initial spring deflection must be at least 4 times the thermal movement. The submittal must also include anchor loads when installed, cold filled, and at operating temperature. Include calculated pipe stress at end conditions and branch off locations as well as installation instruction. The submittal must be stamped and signed by a licensed professional engineer in the employ of the vibration vendor for at least five years.
  3. Proper provision shall be made for seismic protection in seismic zones.
  4. The isolation vendor shall provide and design all brackets at riser spring and anchor locations where standard clamps lack capacity or do not fit. The contractor must install and adjust all isolators under the supervision of the designing isolation vendor or his representative.
  5. The support spring mounts shall be Mason Type SLF, anchors Type ADA and telescoping guides Type VSG.

6. All vertical risers shall be supported by spring isolators designed to support the riser filled with water, if it is a water line.
7. Assigned loads must be within the building design limits at the support points. Neutral central resilient anchors close to the center of the run shall direct movement up and down.
8. The anchors shall be capable of holding an upward force equal to the water weight when the system is drained. If one level cannot accommodate this force, anchors can be located on 2 or 3 adjacent floors.
9. Resilient guides shall be spaced and sized properly depending on the pipe diameter. Submittals must include the initial load, initial deflection, change in deflection, final load and change in load at all spring and anchor support locations, as well as guide spacing.
10. The initial spring deflection shall be a minimum of 0.75"(20mm) or four times the thermal movement at the isolator location, whichever is greater.
11. Calculations shall include pipe stress at end conditions and branch off locations and the manufacturer must include installation instructions. Submittal must be stamped and signed by a licensed professional engineer in the employ of the vibration vendor for at least 5 years.

**B. RESILIENT PIPE GUIDES – Type H-1**

1. Description: Telescopic arrangement of post and sleeve arrangement separated by a minimum 1/2-inch- thick neoprene.
  - a. Pipe guides shall consist of a telescopic arrangement of two sizes of steel tubing separated by a minimum 1/2"(12mm) thickness of 60 durometer or softer neoprene.
  - b. The height of the guides shall be preset with a shear pin to allow vertical motion due to pipe expansion or contraction.
  - c. Guides shall be capable of 1-5/8"(40mm) motion, or to meet location requirements.
  - d. Pipe guides shall be Mason Industries Type VSG.

**C. PIPE ANCHORS – Type H-2**

1. Description: All directional acoustical pipe anchors consist of two sizes of steel tubing separated by a minimum 1/2"(12mm) thickness of 60 duro or softer neoprene.
  - a. Split Seals consist of pipe halves with minimum 3/4"(20mm) thick neoprene sponge cemented to the inner faces.
  - b. Vertical restraint shall be provided by similar material arranged to prevent up or down vertical travel.
  - c. Allowable loads on the isolation material shall not exceed 500 psi (3.45 N/mm<sup>2</sup>) and the design shall be balanced for equal resistance in any direction.
  - d. All directional anchors shall be Mason Industries Type ADA.

**2.7 ACOUSTICAL WALL, CEILING OR FLOOR SEAL – Type I**

- A. Description: Split Seals consist of pipe halves with minimum 3/4"(20mm) thick neoprene sponge cemented to the inner faces.
1. The seal shall be tightened around the pipe to eliminate clearance between the inner sponge face and the piping.
  2. Concrete may be packed around the seal to make it integral with the floor, wall or ceiling if the seal is not in place prior to the construction of the building member.
  3. Seals shall project a minimum of 1"(25mm) past either face of the wall. Where temperatures exceed 240°F (115°C), 10 lb. density fiberglass may be used in lieu of the sponge.
  4. Seals shall be Mason Industries Type SWS.

**2.8 SPRING HANGERS**

**A. Spring Isolator - Type J:**

1. Hangers shall consist of rigid steel frames containing minimum 1-1/4"(32mm) thick neoprene elements at the top and a steel spring seated in a steel washer reinforced neoprene cup on the bottom.
2. The neoprene element and the cup shall have neoprene bushings projecting through the steel box. In order to maintain stability the boxes shall not be articulated as clevis hangers nor the neoprene element stacked on top of the spring.
3. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30° arc from side to side before contacting the cup bushing and short circuiting the spring.
4. The ratio of the spring diameter divided by the compressed spring height shall be no less than 0.8. Springs

- shall have a minimum additional travel to solid equal to 50% of the rated deflection.
- 5. Submittals shall include a hanger drawing showing the 30° capability.
- 6. Hangers shall be Mason Industries - Type 30N.

**B. Spring Isolator – Type K**

- 1. Hangers shall consist of rigid steel frames containing minimum 1-1/4"(32mm) thick neoprene elements at the top and a steel spring seated in a steel washer reinforced neoprene cup on the bottom.
- 2. The neoprene element and the cup shall have neoprene bushings projecting through the steel box. In order to maintain stability the boxes shall not be articulated as clevis hangers nor the neoprene element stacked on top of the spring.
- 3. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30° arc from side to side before contacting the cup bushing and short circuiting the spring.
- 4. The ratio of the spring diameter divided by the compressed spring height shall be no less than 0.8. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection.
- 5. Submittals shall include a hanger drawing showing the 30° capability.
- 6. Hangers shall be pre-compressed and locked at the rated deflection by means of a resilient upstop to keep the piping or equipment at a fixed elevation during installation.
- 7. The hangers shall be designed with a release mechanism to free the spring after the installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale.
- 8. Submittals shall include a drawing of the hanger showing the 30° capability.
- 9. Hangers shall be Mason Industries Type PC30N.

**C. Spring Hanger Guidelines:**

- A. The first four pipe hangers in the main lines near the mechanical equipment shall be Type J.
- B. Hangers supporting piping 2" and larger in all other locations throughout the building shall be isolated by Type I.
- C. Heat exchangers and expansion tanks are considered part of the piping run.
- D. The first four isolators from the isolated equipment shall have the same static deflection as specified for the mountings under the connected equipment.
- E. If piping is connected to equipment located in basements and hangs from ceilings under occupied spaces the first four hangers shall have 0.75" deflection for pipe sizes up to and including 3", 1-1/2" deflection for pipe sizes over 3" and up to and including 6", and 2-1/2" deflection thereafter.
- F. Where piping connects to mechanical equipment install Type R expansion joints or specification P stainless hoses if O is not suitable for the service.
- G. All piping passing through the equipment walls, floors or ceilings shall be protected against sound leakage by means of an acoustical seal, Type J.
- H. All air ducts with a cross section of 2ft<sup>2</sup> or larger shall be isolated from the building structure by Type K hangers with a minimum deflection of 0.75". Isolators shall continue for 50' from the equipment.
- I. If air velocity exceeds 1000 fpm, hangers or supports shall continue for an additional 50' or as shown on the drawings

**2.9 VIBRATION ISOLATION EQUIPMENT BASES**

**A. Steel Bases: Factory-fabricated, welded, structural-steel bases and rails - Type O.**

- 1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
  - a. Include supports for suction and discharge elbows for pumps.
- 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
- 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- 4. Centrifugal refrigeration machines and pump bases may be T or L shaped.
- 5. Pump bases for split case pumps shall be large enough to support suction and discharge elbows.
- 6. All perimeter members shall be steel beams with a minimum depth equal to 1/10 of the longest dimension of the base. Base depth need not exceed 14"(350mm) provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer.
- 7. Height saving brackets shall be employed in all mounting locations to provide a base clearance of 1"(25mm).

8. Bases shall be Mason Industries Type WF or approved equal.

B. Concrete Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete – Type P.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
  - a. Include supports for suction and discharge elbows for pumps.
2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Bases shall be a minimum of 1/12 of the longest dimension of the base but not less than 6".
4. Minimum thickness of the inertia base shall be according to the following tabulation:

Motor Size		Minimum Thickness	
(HP)	(Kw)	(In.)	(mm)
5-15	(4-11)	6	(150)
20-50	(15-37)	8	(200)
60-75	(45-55)	10	(250)
100-250	(75-190)	12	(300)
300-500	(220-375)	18	(350)

4. Forms shall include minimum concrete reinforcing consisting of 1/2" bars welded in place on 6" centers running both ways in a layer 1-1/2" above the bottom. Forms shall be furnished with steel templates to hold the anchor bolt sleeves and anchor bolts while concrete is being poured.
5. Height saving brackets shall be employed in all mounting locations to maintain a 1" clearance below the base.
6. Wooden formed bases leaving a concrete rather than a steel finish are not acceptable.
7. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.
8. Base shall be Mason Industries - Type BMK or K or approved equal.

## 2.10 ISOLATION ROOF-CURB RAILS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Mason Industries, Inc
2. Ace Mountings Co., Inc.
3. Kinetics Noise Control.
4. Thybar Corporation.

B. Spring Isolated Curb – Type Q

1. Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment and shall include the following:
2. Curb mounted rooftop equipment shall be mounted on spring isolation curbs.
3. The lower member shall consist of a sheet metal Z section containing adjustable and removable steel springs that support the upper floating section.
4. The upper frame must provide continuous support for the equipment and must be captive so as to resiliently resist wind forces.
5. Lower Support Assembly: The lower support assembly shall be formed sheet metal section containing adjustable and removable steel springs that support upper frame. The lower support assembly shall have a means for attaching to building structure and a wood nailer for attaching roof materials and shall be insulated with a minimum of 2 inches of rigid glass-fiber insulation on inside of assembly. Adjustable, restrained-spring isolators shall be mounted on elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.
6. All directional neoprene snubber bushings shall be a minimum of 1/4"(6mm) thick.
7. Steel springs shall be laterally stable and rest on 1/4"(6mm) thick neoprene acoustical pads.
8. Hardware must be plated and the springs provided with a rust resistant finish.

9. The curbs waterproofing shall consist of a continuous galvanized flexible counter flashing nailed over the lower curb's waterproofing and joined at the corners by EPDM bellows.
10. All spring locations shall have access ports with removable waterproof covers. Lower curbs shall have provision for 2"(50mm) of insulation.
11. Curb shall be Mason Industries - Type RSC or approved equal.

C. Vibration Isolation Bases – Type R

1. Curb mounted rooftop equipment shall be mounted on vibration isolation bases that fit over the roof curb and under the isolated equipment.
2. The extruded aluminum top member shall overlap the bottom to provide water runoff independent of the seal. Aluminum members shall house electro galvanized or powder coated springs selected for 0.75"(20mm) minimum deflection.
3. Travel to solid shall be 1.5"(40mm) minimum.
4. Spring diameters shall be no less than 0.8 of the spring height at rated load. Wind resistance shall be provided by means of resilient snubbers in the corners with a minimum clearance of 1/4"(6mm) so as not to interfere with the spring action except in high winds.
5. Manufacturer's self adhering closed cell sponge gasketing must be used both above and below the base and a flexible EPDM duct like connection shall seal the outside perimeter.
6. Foam or other sliding or shear seals are unacceptable in lieu of the EPDM ductlike closure.
7. Submittals shall include spring deflections, spring diameters, compressed spring height and solid spring height as well as seal and wind resistance details.
8. Curb mounted bases shall be Mason Industries - Type CMAB or approved equal.

## 2.11 FLEXIBLE HOSES

A. Flexible Stainless Steel Hoses – Type T:

1. Flexible stainless steel hose shall have stainless steel braid and carbon steel fittings. Sizes 3" and larger shall be flanged. Smaller sizes may have male nipples. Minimum lengths shall be as tabulated below:

Flanged		
3" x 12"	6" x 18"	12" x 24"
4" x 12"	8" x 18"	14" x 30"
5" x 18"	10" x 18"	16" x 18"
Male Nipples		
1/2" x 12"	1-1/4" x 12"	2" x 12"
3/4" x 12"	1-1/2" x 12"	2-1/2" x 18"
1" x 12"		

2. At equipment, hoses shall be installed on the equipment side of the shut off valves horizontal and parallel to the equipment shafts wherever possible.
3. Hoses shall be Mason Industries - Type FFL.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.



### **3.2 VIBRATION CONTROL DEVICE INSTALLATION**

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Division 03 Section "Cast-in-Place Concrete."
- B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- C. All vibration isolators must be installed in strict accordance with the manufacturers written instructions and all certified submittal data.
- D. Installation of vibration isolators must not cause any change of position of equipment, piping or duct work resulting in stresses or misalignment.
- E. No rigid connections between equipment and the building structure shall be made that degrades the noise and vibration control system herein specified.
- F. The contractor shall not install any equipment, piping, duct or conduit which makes rigid connections with the building unless isolation is not specified. "Building" includes, but is not limited to, slabs, beams, columns, studs and walls.
- G. Coordinate work with other trades to avoid rigid contact with the building.
- H. Any conflicts with other trades which will result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions should be brought to the architects/engineers attention prior to installation. Corrective work necessitated by conflicts after installation shall be at the responsible contractor's expense.
- I. Bring to the architects/engineers attention any discrepancies between the specifications and the field conditions or changes required due to specific equipment selection, prior to installation. Corrective work necessitated by discrepancies after installation shall be at the responsible contractor's expense.
- J. Correct, at no additional cost, all installations which are deemed defective in workmanship and materials at the contractor's expense.
- K. Where piping passes through walls, floors or ceilings the vibration isolation manufacturer shall provide Type G seals.
- L. Locate isolation hangers as near to the overhead support structure as possible.
- M. Air handling equipment and centrifugal fans shall be protected against excessive displacement which results from high air thrust when thrust forces exceed 10% of the equipment weight. Horizontal thrust restraints shall be Type J restraints.
- N. Rooftop equipment isolators must be bolted to the equipment and structure. Mountings must be designed to resist 100m/h wind loads.

### **3.3 VIBRATION ISOLATION EQUIPMENT BASES INSTALLATION**

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Division 03 Section 033000 "Cast-in-Place Concrete."

### **3.4 INSPECTION**

- A. On completion of installation of all vibration isolation devices herein specified, the local representative of the isolation materials manufacturer(s) shall inspect the completed system and report in writing any installation errors, improperly selected isolation devices, or other faults that could affect the performance of the system. Contractor shall submit a report to the Architect, including the manufacturer's representative's final report, indicating all

isolation reported as properly installed or requiring correction, and include a report by the Contractor on steps taken to properly complete the isolation work.

**PART 4 – ISOLATOR APPLICATION SCHEDULE**

ISOLATION SELECTION GUIDE			EQUIPMENT INSTALLATION ARRANGEMENT					
			MOUNTED			SUSPENDED		
EQUIPMENT	SIZE	LOCATION	BASE TYPE	ISOLATOR TYPE	DEFL (in.)	BASE TYPE	ISOLATOR TYPE	DEFL (in.)
Air Handlers Without Internal Isolated Fan Sections Below – 300 rpm (or VFD) 301 – 450 rpm 451 – 600 rpm 601 – 750 rpm 751 – 850 rpm 851 - greater		Above Grade	Per Mfr.	E		Per Mfr.	J,K	
					4.0			4.25
					3.5			3.75
					3.0			3.25
					2.0			2.25
					1.5			1.75
					1.0			1.25
Air Handlers <b>WITH</b> Internal Isolated Fans		Above Grade	Per Mfr.	A	0.25		D	0.5
Air Handlers		ON GRADE	Per Mfr.	A	0.25	----	----	----
Condensate Pumps		All	Per Mfr.	A	0.10	----	----	----
Air-Cooled Condenser		All	Per Mfr.	F	2.0	----	----	----
PUMPS <sup>(3)</sup> - Mechanical and Domestic Water	5HP +	All	P	F <sup>(1),(2)</sup>	2.0	Per Mfr.	J,K	2.25
	< 5HP		P	B	0.5		D	0.5
	VFD		P	F <sup>(1),(2)</sup>	4.0		J,K	4.25
Cooling Towers Below – 300 rpm (or VFD) 301 – 450 rpm 451 – 600 rpm 601 – 750 rpm 751 – 850 rpm		Above Grade	Per Mfr.	F		----	----	----
					4.0			
					3.5			
					3.0			
					2.0			
					1.5			
851 - greater			1.0					
Boilers		Above Grade	Per Mfr.	F	1.0	----	----	----
Chillers – Absorption, Centrifugal, Rotary/Screw		Above Grade	Per Mfr.	F <sup>(1)</sup>	1.0	----	----	----
Fans – Cabinet, Centrifugal, In-Line Centrif.				F <sup>(1)</sup>		Per Mfr.	J,K	
Below – 300 rpm (or VFD)			P		4.0			4.25
301 – 450 rpm			O		3.5			3.75
451 – 600 rpm			O		3.0			3.25
601 – 750 rpm			O		2.0			2.25
751 – 850 rpm			O		1.5			1.75
851 - greater			O		1.0			1.25
Curb Mounted Roof Equip.		Roof	O	Q,R	Per fan RPM above	----	----	----
Vertical Pipe Riser		All		H	0.75		H,I	0.75
Horizontal Piping		ALL		E			I,J,K	

**Notes for Isolation Selection Guide**

- (1) Double Layer neoprene isolation pads to be included within spring assembly cup.
- (2) Electrical Connections to be made with minimum 18" flexible conduit.
- (3) In-Line Pumps to be mounted per manufacturer's recommendations.

**END OF SECTION 230548.13**

**SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Equipment labels.
  - 2. Warning signs and labels.
  - 3. Pipe labels.
  - 4. Duct labels.
  - 5. Stencils.
  - 6. Valve tags.
  - 7. Warning tags.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

**1.4 COORDINATION**

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

**PART 2 - PRODUCTS**

**2.1 EQUIPMENT LABELS**

- A. Metal Labels for Equipment:
  - 1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
  - 2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  - 3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
  - 4. Fasteners: Stainless-steel rivets.
  - 5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

**2.2 WARNING SIGNS AND LABELS**

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Red.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

**2.3 PIPE LABELS**

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
  2. Lettering Size: At least 1-1/2 inches high.

## **2.4 DUCT LABELS**

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black.
- C. Background Color: White.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
  2. Lettering Size: At least 1-1/2 inches high.

## **2.5 STENCILS**

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.
1. Stencil Material: Aluminum.
  2. Stencil Paint: Exterior, gloss, alkyd enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
  3. Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1 unless otherwise indicated.

## **2.6 VALVE TAGS**

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
  2. Fasteners: Brass wire-link or beaded chain; or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position

(open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

## **2.7 WARNING TAGS**

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
  1. Size: 3 by 5-1/4 inches minimum.
  2. Fasteners: Brass grommet and wire.
  3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
  4. Color: Yellow background with black lettering.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

### **3.2 EQUIPMENT LABEL INSTALLATION**

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

### **3.3 PIPE LABEL INSTALLATION**

- A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  1. Near each valve and control device.
  2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
  4. At access doors, manholes, and similar access points that permit view of concealed piping.
  5. Near major equipment items and other points of origination and termination.
  6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
  7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Pipe Label Color Schedule:
  1. Chilled Water Piping:
    - a. Background Color: Green.
    - b. Letter Color: White.
  2. Hot Water Piping:
    - a. Background Color: Green.
    - b. Letter Color: White.
  3. Refrigerant Piping:
    - a. Background Color: Green.

- b. Letter Color: White.
- 4. Cold Condensate drain piping:
  - a. Background Color: Green.
  - b. Letter Color: White.
- 5. Cold water makeup piping:
  - a. Background Color: Green.
  - b. Letter Color: White.
- 6. Low Pressure Steam Piping:
  - a. Background Color: Purple.
  - b. Letter Color White.
- 7. Steam Condensate Piping:
  - a. Background Color: Purple.
  - b. Letter Color White.

### **3.4 DUCT LABEL INSTALLATION**

- A. Install plastic-laminated duct labels with permanent adhesive on air ducts in the following color codes:
  - 1. Blue: For cold-air supply ducts.
  - 2. Yellow: For hot-air supply ducts.
  - 3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
  - 4. ASME A13.1 Colors and Designs: For hazardous material exhaust:
    - a. Orange background with black lettering.
- B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

### **3.5 VALVE-TAG INSTALLATION**

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
  - 1. Valve-Tag Size and Shape:
    - a. Chilled Water: 2 inches, round.
    - b. Steam: 2 inches.
    - c. Refrigerant: 2 inches, round.
    - d. Heating Water: 2 inches, round.
  - 2. Valve-Tag Color:
    - a. Chilled Water: Natural brass.
    - b. Steam: Natural brass.
    - c. Refrigerant: Natural brass.
    - d. Heating Water: Natural brass.



- 3. Letter Color:
  - a. Chilled Water: Black.
  - b. Steam: Black.
  - c. Refrigerant: Black.
  - d. Hot Water: Black.

**3.6 WARNING-TAG INSTALLATION**

- A. Write required message on, and attach warning tags to, equipment and other items where required.

**END OF SECTION 230553**

**SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Balancing Air Systems:
    - a. Constant-volume air systems.
    - b. Variable-air-volume systems.
  - 2. Balancing Hydronic Piping Systems:
    - a. Constant-flow hydronic systems.
    - b. Variable-flow hydronic systems.

**1.3 DEFINITIONS**

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

**1.4 ACTION SUBMITTALS**

**1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: Within 10 business days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 10 business days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Within 30 business days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- D. Certified TAB reports.
- E. Sample report forms.
- F. Instrument calibration reports, to include the following:
  - 1. Instrument type and make.
  - 2. Serial number.
  - 3. Application.
  - 4. Dates of use.
  - 5. Dates of calibration.

**1.6 QUALITY ASSURANCE**

- A. TAB Contractor Qualifications:
  - 1. Engage a TAB entity certified by AABC or as approved by the Engineer before the commencement of work.
    - a. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC.
    - b. TAB Technician: Employee of the TAB contractor and who is certified by AABC as a TAB technician.
  - 2. TAB Contractor shall be an independent company not associated with the HVAC contractor.
  - 3. TAB Contractor must submit the following project references, subject to Engineer's review and approval/rejection before commencement of work:
    - a. 5 projects with water cooled chillers and variable primary flow chilled water pumping.
    - b. 5 projects with cooling towers and constant flow condenser water pumping.
    - c. 5 projects with condensing boilers and variable primary flow hot water pumping.
- B. TAB Conference: Meet with Commissioning Authority on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide seven days' advance notice of scheduled meeting time and location.
  - 1. Agenda Items:
    - a. The Contract Documents examination report.
    - b. The TAB plan.
    - c. Coordination and cooperation of trades and subcontractors.
    - d. Coordination of documentation and communication flow.
- C. Certify TAB field data reports and perform the following:
  - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
  - 2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- D. TAB Report Forms: Use standard TAB contractor's forms approved by Engineer and Commissioning Authority.
- E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."
- F. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- G. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

**1.7 PROJECT CONDITIONS**

- A. Full Owner Occupancy: Owner may occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

**1.8 COORDINATION**

- A. Notice: Provide five business days' advance notice for each test. Include scheduled test dates and times.
- B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

**PART 2 - PRODUCTS (Not Applicable)**

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Division 23 Section "Metal Ducts" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.
  - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
  - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
- L. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- N. Examine system pumps to ensure absence of entrained air in the suction piping.
- O. Examine operating safety interlocks and controls on HVAC equipment.
- P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

### **3.2 PREPARATION**

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
  - 1. Permanent electrical-power wiring is complete.
  - 2. Hydronic systems are filled, clean, and free of air.
  - 3. Automatic temperature-control systems are operational.
  - 4. Equipment and duct access doors are securely closed.
  - 5. Balance, smoke, and fire dampers are open.
  - 6. Isolating and balancing valves are open and control valves are operational.
  - 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
  - 8. Windows and doors can be closed so indicated conditions for system operations can be met.

### **3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING**

- A. Perform testing and balancing procedures on each system according to the procedures contained in ASHRAE 111 or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.
  - 1. Comply with requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
  - 1. After testing and balancing, install test ports and duct access doors that comply with requirements in Division 23 Section "Air Duct Accessories."
  - 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "Duct Insulation," Division 23 Section "HVAC Equipment Insulation," and Division 23 Section "HVAC Piping Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

### **3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS**

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.

- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.
- L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

### **3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS**

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
  - 1. Measure total airflow.
    - a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
  - 2. Measure fan static pressures as follows to determine actual static pressure:
    - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
    - b. Measure static pressure directly at the fan outlet or through the flexible connection.
    - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
    - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
  - 3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
    - a. Report the cleanliness status of filters and the time static pressures are measured.
  - 4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
  - 5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
  - 6. Obtain approval from Engineer for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
  - 7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
  - 1. Measure airflow of submain and branch ducts.
    - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
  - 2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
  - 3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.
  - 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

### **3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS**

- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.

- B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
3. Measure total system airflow. Adjust to within indicated airflow.
4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
  - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
  - a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
8. Record final fan-performance data.

### **3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS**

- A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
1. Open all manual valves for maximum flow.
  2. Check liquid level in expansion tank.
  3. Check makeup water-station pressure gage for adequate pressure for highest vent.

4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

### **3.8 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS**

- A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:
  1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
    - a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Engineer and comply with requirements in Division 23 Section "Hydronic Pumps."
  2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
    - a. Monitor motor performance during procedures and do not operate motors in overload conditions.
  3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
  4. Report flow rates that are not within plus or minus 10 percent of design.
- B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.
- C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.
- D. Set calibrated balancing valves, if installed, at calculated presettings.
- E. Measure flow at all stations and adjust, where necessary, to obtain first balance.
  1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
  1. Determine the balancing station with the highest percentage over indicated flow.
  2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
  3. Record settings and mark balancing devices.
- H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.
- J. Check settings and operation of each safety valve. Record settings.



**3.9 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS**

- A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

**3.10 PROCEDURES FOR MOTORS**

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
  - 1. Manufacturer's name, model number, and serial number.
  - 2. Motor horsepower rating.
  - 3. Motor rpm.
  - 4. Efficiency rating.
  - 5. Nameplate and measured voltage, each phase.
  - 6. Nameplate and measured amperage, each phase.
  - 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

**3.11 PROCEDURES FOR CONDENSING UNITS**

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

**3.12 PROCEDURES FOR BOILERS**

- A. Hydronic Boilers: Measure and record entering- and leaving-water temperatures and water flow.

**3.13 PROCEDURES FOR HEAT EXCHANGERS**

- A. Measure water flow through all circuits.
- B. Adjust water flow to within specified tolerances.
- C. Measure inlet and outlet water temperatures.
- D. Measure inlet steam pressure.
- E. Check settings and operation of safety and relief valves. Record settings.

**3.14 PROCEDURES FOR HEAT-TRANSFER COILS**

- A. Measure, adjust, and record the following data for each water coil:
  - 1. Entering- and leaving-water temperature.
  - 2. Water flow rate.
  - 3. Water pressure drop.
  - 4. Dry-bulb temperature of entering and leaving air.
  - 5. Wet-bulb temperature of entering and leaving air for cooling coils.
  - 6. Airflow.

7. Air pressure drop.

B. Measure, adjust, and record the following data for each electric heating coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load and at each incremental stage.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

C. Measure, adjust, and record the following data for each steam coil:

1. Dry-bulb temperature of entering and leaving air.
2. Airflow.
3. Air pressure drop.
4. Inlet steam pressure.

D. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

### 3.15 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.
3. Heating-Water Flow Rate: Plus or minus 10 percent.
4. Cooling-Water Flow Rate: Plus or minus 10 percent.

### 3.16 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: Prepare weekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

### 3.17 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
  2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
1. Pump curves.

2. Fan curves.
  3. Manufacturers' test data.
  4. Field test reports prepared by system and equipment installers.
  5. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.
  2. Name and address of the TAB contractor.
  3. Project name.
  4. Project location.
  5. Architect's name and address.
  6. Engineer's name and address.
  7. Contractor's name and address.
  8. Report date.
  9. Signature of TAB supervisor who certifies the report.
  10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
  11. Summary of contents including the following:
    - a. Indicated versus final performance.
    - b. Notable characteristics of systems.
    - c. Description of system operation sequence if it varies from the Contract Documents.
  12. Nomenclature sheets for each item of equipment.
  13. Data for terminal units, including manufacturer's name, type, size, and fittings.
  14. Notes to explain why certain final data in the body of reports vary from indicated values.
  15. Test conditions for fans and pump performance forms including the following:
    - a. Settings for outdoor-, return-, and exhaust-air dampers.
    - b. Conditions of filters.
    - c. Cooling coil, wet- and dry-bulb conditions.
    - d. Face and bypass damper settings at coils.
    - e. Fan drive settings including settings and percentage of maximum pitch diameter.
    - f. Inlet vane settings for variable-air-volume systems.
    - g. Settings for supply-air, static-pressure controller.
    - h. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
  2. Water flow rates.
  3. Duct, outlet, and inlet sizes.
  4. Pipe and valve sizes and locations.
  5. Terminal units.
  6. Balancing stations.
  7. Position of balancing devices.
- E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data:
    - a. Unit identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and unit size.
    - e. Manufacturer's serial number.
    - f. Unit arrangement and class.
    - g. Discharge arrangement.

- h. Sheave make, size in inches, and bore.
  - i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
  - j. Number, make, and size of belts.
  - k. Number, type, and size of filters.
- 2. Motor Data:
  - a. Motor make, and frame type and size.
  - b. Horsepower and rpm.
  - c. Volts, phase, and hertz.
  - d. Full-load amperage and service factor.
  - e. Sheave make, size in inches, and bore.
  - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
- 3. Test Data (Indicated and Actual Values):
  - a. Total air flow rate in cfm.
  - b. Total system static pressure in inches wg.
  - c. Fan rpm.
  - d. Discharge static pressure in inches wg.
  - e. Filter static-pressure differential in inches wg.
  - f. Preheat-coil static-pressure differential in inches wg.
  - g. Cooling-coil static-pressure differential in inches wg.
  - h. Heating-coil static-pressure differential in inches wg.
  - i. Outdoor airflow in cfm.
  - j. Return airflow in cfm.
  - k. Outdoor-air damper position.
  - l. Return-air damper position.
  - m. Vortex damper position.

F. Apparatus-Coil Test Reports:

- 1. Coil Data:
  - a. System identification.
  - b. Location.
  - c. Coil type.
  - d. Number of rows.
  - e. Fin spacing in fins per inch o.c.
  - f. Make and model number.
  - g. Face area in sq. ft..
  - h. Tube size in NPS.
  - i. Tube and fin materials.
  - j. Circuiting arrangement.
- 2. Test Data (Indicated and Actual Values):
  - a. Air flow rate in cfm.
  - b. Average face velocity in fpm.
  - c. Air pressure drop in inches wg.
  - d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
  - e. Return-air, wet- and dry-bulb temperatures in deg F.
  - f. Entering-air, wet- and dry-bulb temperatures in deg F.
  - g. Leaving-air, wet- and dry-bulb temperatures in deg F.
  - h. Water flow rate in gpm.
  - i. Water pressure differential in feet of head or psig.
  - j. Entering-water temperature in deg F.
  - k. Leaving-water temperature in deg F.
  - l. Refrigerant expansion valve and refrigerant types.
  - m. Refrigerant suction pressure in psig.

- n. Refrigerant suction temperature in deg F.
  - o. Inlet steam pressure in psig.
- G. Fan Test Reports: For supply, return, and exhaust fans, include the following:
  - 1. Fan Data:
    - a. System identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and size.
    - e. Manufacturer's serial number.
    - f. Arrangement and class.
    - g. Sheave make, size in inches, and bore.
    - h. Center-to-center dimensions of sheave, and amount of adjustments in inches.
  - 2. Motor Data:
    - a. Motor make, and frame type and size.
    - b. Horsepower and rpm.
    - c. Volts, phase, and hertz.
    - d. Full-load amperage and service factor.
    - e. Sheave make, size in inches, and bore.
    - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
    - g. Number, make, and size of belts.
  - 3. Test Data (Indicated and Actual Values):
    - a. Total airflow rate in cfm.
    - b. Total system static pressure in inches wg.
    - c. Fan rpm.
    - d. Discharge static pressure in inches wg.
    - e. Suction static pressure in inches wg.
- H. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
  - 1. Report Data:
    - a. System and air-handling-unit number.
    - b. Location and zone.
    - c. Traverse air temperature in deg F.
    - d. Duct static pressure in inches wg.
    - e. Duct size in inches.
    - f. Duct area in sq. ft..
    - g. Indicated air flow rate in cfm.
    - h. Indicated velocity in fpm.
    - i. Actual air flow rate in cfm.
    - j. Actual average velocity in fpm.
    - k. Barometric pressure in psig.
- I. Air-Terminal-Device Reports:
  - 1. Unit Data:
    - a. System and air-handling unit identification.
    - b. Location and zone.
    - c. Apparatus used for test.
    - d. Area served.
    - e. Make.

- f. Number from system diagram.
    - g. Type and model number.
    - h. Size.
    - i. Effective area in sq. ft..
  - 2. Test Data (Indicated and Actual Values):
    - a. Air flow rate in cfm.
    - b. Air velocity in fpm.
    - c. Preliminary air flow rate as needed in cfm.
    - d. Preliminary velocity as needed in fpm.
    - e. Final air flow rate in cfm.
    - f. Final velocity in fpm.
    - g. Space temperature in deg F.
- J. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
- 1. Unit Data:
    - a. System and air-handling-unit identification.
    - b. Location and zone.
    - c. Room or riser served.
    - d. Coil make and size.
    - e. Flowmeter type.
  - 2. Test Data (Indicated and Actual Values):
    - a. Air flow rate in cfm.
    - b. Entering-water temperature in deg F.
    - c. Leaving-water temperature in deg F.
    - d. Water pressure drop in feet of head or psig.
    - e. Entering-air temperature in deg F.
    - f. Leaving-air temperature in deg F.
- K. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
- 1. Unit Data:
    - a. Unit identification.
    - b. Location.
    - c. Service.
    - d. Make and size.
    - e. Model number and serial number.
    - f. Water flow rate in gpm.
    - g. Water pressure differential in feet of head or psig.
    - h. Required net positive suction head in feet of head or psig.
    - i. Pump rpm.
    - j. Impeller diameter in inches.
    - k. Motor make and frame size.
    - l. Motor horsepower and rpm.
    - m. Voltage at each connection.
    - n. Amperage for each phase.
    - o. Full-load amperage and service factor.
    - p. Seal type.
  - 2. Test Data (Indicated and Actual Values):
    - a. Static head in feet of head or psig.
    - b. Pump shutoff pressure in feet of head or psig.
    - c. Actual impeller size in inches.

- d. Full-open flow rate in gpm.
- e. Full-open pressure in feet of head or psig.
- f. Final discharge pressure in feet of head or psig.
- g. Final suction pressure in feet of head or psig.
- h. Final total pressure in feet of head or psig.
- i. Final water flow rate in gpm.
- j. Voltage at each connection.
- k. Amperage for each phase.

L. Instrument Calibration Reports:

1. Report Data:

- a. Instrument type and make.
- b. Serial number.
- c. Application.
- d. Dates of use.
- e. Dates of calibration.

**3.18 INSPECTIONS**

A. Initial Inspection:

- 1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
- 2. Check the following for each system:
  - a. Measure airflow of at least 10 percent of air outlets.
  - b. Measure water flow of at least 5 percent of terminals.
  - c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
  - d. Verify that balancing devices are marked with final balance position.
  - e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

- 1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Commissioning Authority.
- 2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Commissioning Authority.
- 3. Commissioning Authority shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
- 4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- 5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

- 1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
- 2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

D. Prepare test and inspection reports.

**3.19      ADDITIONAL TESTS**

- A.      Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B.      Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

**END OF SECTION 230593**



## SECTION 230713 - DUCT INSULATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes insulating the following duct services:
1. Indoor, concealed supply and outdoor air.
  2. Indoor, exposed supply and outdoor air.
  3. Indoor, concealed return located in unconditioned space.
  4. Indoor, exposed return located in unconditioned space.
  5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
  6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
  7. Outdoor, concealed supply and return.
  8. Outdoor, exposed supply and return.
- B. Related Sections:
1. Division 23 Section "HVAC Equipment Insulation."
  2. Division 23 Section "HVAC Piping Insulation."
  3. Division 23 Section "Metal Ducts" for duct liners.
- C. References:
1. ASTM International (ASTM)
  2. American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. (ASHRAE)
  3. North American Insulation Manufacturers Association (NAIMA)
  4. National Fire Protection Association (NFPA)
  5. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
  6. Underwriter's Laboratories (UL)
  7. Underwriter's Laboratories Environment and UL Environment/GREENGUARD.
  8. UL 2824 – GREENGUARD Certification Program Method for Measuring Microbial Resistance From Various Sources Using Static Environmental Chambers.
  - 9.
- B. Definitions:
1. Thermal Conductivity (k value): Btu•in./hr.•ft<sup>2</sup>•°F
  2. UL Environment and UL Environment GREENGUARD provides independent, third-party, Indoor Air Quality (IAQ) certification of products for emissions of respirable particles and Volatile Organic Compounds (VOC's), including formaldehyde and other specific product-related pollutants. Certification is based upon criteria used by EPA, OSHA and WHO.
  3. IAQ: Indoor Air Quality
  4. EPA: Environmental Protection Agency
  5. WHO: World Health Organization
  6. ASJ+: All Service Jacket composed of aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film layer leaving no paper exposed.
  7. ASJ: All Service Jacket
  8. SSL+: Self-sealing Advanced Closure System
  9. SSL: Self-Sealing Lap
  10. FSK: Foil-Scrim-Kraft; jacketing
  11. PSK: Poly-Scrim-Kraft; jacketing
  12. PVC: Polyvinyl Chloride
  13. FRP: Fiberglass Reinforced Plastic

14. ECOSE® Technology: a binder system based on rapidly renewable bio-based materials rather than petroleum-based chemicals commonly used in other fiber glass insulation products. ECOSE Technology reduces our binder embodied energy by up to 70% and does not contain phenol, formaldehyde, acrylics or artificial colors.
15. UL Environment GOLD Certification: (Formerly known as GREENGUARD CHILDREN & SCHOOLS Certification) offers stricter certification criteria, considers safety factors to account for sensitive individuals (such as children and the elderly), and ensures that a product is acceptable for use in environments such as schools and healthcare facilities. It is referenced by both The Collaborative for High Performance Schools (CHPS) and the Leadership in Energy and Environmental Design (LEED) Building Rating Systems.
16. UL Environment Validated- Formaldehyde Free Verification Requirements: for a product to be verified as formaldehyde free, product samples must have a measured emission factor of less than or equal to 5 µg/m<sup>2</sup> h at 24 elapsed hours or 3 µg/m<sup>2</sup> h at 336 elapsed hours. An emission factor of 5 µg/m<sup>2</sup> h, corresponds to a measured chamber concentration of 2.5 µg/m<sup>3</sup> for a typical building ratio of 0.5 m<sup>2</sup>/m<sup>3</sup>. This chamber concentration is comparable to, or below typical outdoor air concentrations. This demonstrates that the formaldehyde exposure from products labeled as formaldehyde free will not contribute to airborne formaldehyde concentrations at greater levels than those found in the natural outdoor environment.
17. Declare and The Living Building Challenge – The Living Building Challenge is a philosophy, advocacy tool and certification program that addresses development at all scales. The purpose of The Living Building Challenge is to define the most advanced measure of sustainability in the built environment today and acts to diminish the gap between current limits and ideal solutions. Declare supports The Living Building Challenge by providing a transparent materials database that project teams can select from to meet Imperative 11.
18. Imperative 11, Red List – requires that manufacturers disclose the ingredients in their products to insure that they are free of Red List chemicals and materials. The Red List represents the “worst in class” materials, chemicals and elements known to pose serious risks to human health and the greater ecosystem.
19. Underwriter’s Laboratories Environment and UL Environment/GREENGUARD: offers independent green claims validation, product assessment and certification.  
UL Environment and UL Environment GREENGUARD provides third-party credibility for sustainable products.
20. UL Environment Claims Validation (ECV): service and label tests a manufacturer’s product and validates that the environmental claims they make in their marketing and packaging materials are factual. This Environmental Claims Validation (ECV) service will allow manufacturers to verify that their products contain a quantifiable amount of recycled content and, as such, help limit raw material extraction and reduce landfill waste. Furthermore, UL ECV can validate that a product is Formaldehyde Free. It also will enable products to qualify for LEED® points under Pilot Credit 43: MR – Certified Products.
21. EUCEB: exonerated fiber from a health and safety standpoint by the European Certification Board process.
22. Recycled content – post-consumer: materials such as bottled glass collected at curbside or other collection sites after consumer use and used in the manufacturing process to create a new product rather than being placed in a landfill or incinerated.
23. Recycled content – pre-consumer (aka post-industrial): materials used or created from one manufacturing process which are collected as scrap and placed back into another manufacturing process rather than being placed in a landfill or incinerated.
24. Polybrominated diphenyl ethers (PBDE) such as Penta-BDE, Octa-BDE or Deca-BDE fire retardants:
25. UL Classified: UL has tested and evaluated samples of the product with respect to certain properties of the product. UL Classifies products to:
  - a. Applicable UL requirements
  - b. Standards for safety
  - c. Standards of other National and International organizations
26. EPD: Environmental Product Declaration. A third party verified document that reports environmental data of products based on the Life Cycle Assessment (LCA) and other relevant information, and in accordance with the International Standard ISO 14025 (Type III Environmental Declarations).

## **1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).
- B. EPD Submittals: As certified by UL Environment.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
  - 3. Detail application of field-applied jackets.
  - 4. Detail application at linkages of control devices.

## **1.3 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

## **1.4 QUALITY ASSURANCE**

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to UL 723 **or** ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
  - 3. Supply fiber glass insulation products that are manufactured using a minimum of 50% "post-consumer" recycled material. Request 3<sup>rd</sup> party verification such as ULE.
  - 4. Supply fiber glass insulation products that are manufactured using a bio-based binder rather than non-renewable petroleum-based chemicals and with a binder that does not contain phenol, formaldehyde, or acrylics; whenever possible. Request 3<sup>rd</sup> party verification such as ULE.
  - 5. Supply fiber glass insulation products that have achieved UL GOLD Certification and are verified formaldehyde free by UL Environment Validated or UL GREENGUARD; whenever possible. Request 3<sup>rd</sup> party verification such as ULE.
  - 6. Supply fiber glass insulation products that are Living Building Challenge – Declare, Red List free whenever possible.
  - 7. Products shall contain no polybrominated diphenyl ethers (PBDE) such as Penta-BDE, Octa-BDE or Deca-BDE fire retardants; whenever available.
  - 8. WET: Contractor shall take precaution to protect insulation materials from moisture exposure or physical damage. Any fiber glass insulation that becomes wet or damaged shall be replaced at no additional cost.
    - a. HVAC duct work insulation used in the air stream must be discarded if exposed to liquid water.
    - b. Pipe Insulation with factory applied ASJ+ facing having been installed per manufacturer's installation recommendation which may experience intermittent exposure to liquid water after installation may be exempted from removal and replacement requirements.

## **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

## 1.6 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

## 1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

## PART 2 - PRODUCTS

### 2.1 INSULATION MATERIALS

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain formaldehyde, asbestos, lead, mercury, or mercury compounds, whenever possible.
- C. Insulation materials applied to carbon steel shall be Mass Load Corrosion Rate (MLCR) tested per ASTM C 1617.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Products shall contain no polybrominated diphenyl ethers (PBDE) such as Penta-BDE, Octa-BDE or Deca-BDE fire retardants; whenever available.
- F. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Types I, II and III, ASTM C 1136 Type II and ASTM C 1290, Type I with factory-applied FSK jacket. UL/ULC Classified FSK, FHC 25/50 per ASTM E 84 for PSK only. UL GREENGUARD Gold Certified and UL Environment Validated to be formaldehyde free. Product shall contain no polybrominated diphenyl ethers (PBDE) such as Penta-BDE, Octa-BDE or Deca-BDE. For duct and plenum applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Knauf Insulation; Atmosphere Duct Wrap with ECOSE Technology.
    - b. CertainTeed Corp.; SoftTouch Duct Wrap.
    - c. Johns Manville; Microlite.
    - d. Manson Insulation Inc.; Alley Wrap.
    - e. Owens Corning; SOFTR All-Service Duct Wrap.
- H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Products: Subject to compliance with requirements, provide one of the following:

- a. Knauf Insulation; Insulation Board with ECOSE Technology.
- b. CertainTeed Corp.; Commercial Board.
- c. Johns Manville; 800 Series Spin-Glas.
- d. Manson Insulation Inc.; AK Board.
- e. Owens Corning; Fiberglas 700 Series.

## 2.2 FIRE-RATED INSULATION SYSTEMS

- A. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to 1700 deg F. Comply with ASTM C 656, Type II, Grade 6. Tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Johns Manville; Super Firetemp M.
- B. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. 3M; Fire Barrier Wrap Products.
    - b. Unifrax Corporation; FyreWrap.
    - c. CertainTeed Corp.; FlameChek
    - d. Johns Manville; Firetemp Wrap.
    - e. Nelson Fire Stop Products; Nelson FSB Flameshield Blanket.
    - f. Thermal Ceramics; FireMaster Duct Wrap
  - 2. Provide products that are listed by at least one the following
    - a. Underwriters Laboratories Inc. (UL), in "Fire Resistance Directory" category HNLJ, HNMF or XHEZ as appropriate.
    - b. Intertek Testing Services (ITS) (formerly Omega Point Laboratories (OPL)), in "Intertek Directory of Listed Products."
    - c. International Code Council, Evaluation Services (ICC-ES). See report ESR-1255.
    - d. Any other qualified independent testing and inspection agency that conducts periodic follow-up inspections.
  - 3. Fire-resistant Enclosure Listings:
    - a. Ventilation Duct:
      - Intertek 3MU/DI 60-01, 3MU/DI 120-01
      - UL: HNLJ.V-27
  - 4. Firestop Listings: The following is only a partial list of ASTM E 814 tested through-penetration designs. Consult with the manufacturer for more information.
    - a. UL: W-L-7180, W-J-7104, C-AJ-7096, F-C-7054.
    - b. Intertek (formerly Omega Point Laboratories): Note: Intertek Design Listings for fire-resistant enclosures contain the information about firestopping the ducts where they penetrate a fire rated assembly; they are stand-alone listings which do not require an additional firestop listing.
  - 5. Fire Rating (Ventilation Air Duct): All duct wraps must be One (1) hour rated, but in no case less than the rating of any time-rated assemblies which are penetrated.
  - 6. Fire Rating (Ventilation Air Duct): All duct wraps must be Two (2) hour rated, but in no case less than the rating of any time-rated assemblies which are penetrated.
  - 7. Fire Rating (Plenum Rated): All plenum wraps must be compliant to NFPA 262 (electrical cables) and/or UL 1887 (non-metallic pipe).
  - 8. Fire Rated Duct Wrap Insulation:

- a. 3M Fire Barrier Duct Wrap 615+: Lightweight, non-asbestos, high temperature, bio-soluble, calcium-magnesium-silicate (CMS) non-woven blanket, encapsulated in a scrim-reinforced foil, blanket thickness of 1.5 inches (38 mm) for ventilation and grease duct applications.
  - i. Color: White blanket, aluminum foil encapsulated.
  - ii. Weight: 0.9 psf (4.38 kg/m<sup>2</sup>).
  - iii. Density: 6 pcf nominal.
  - iv. Thermal Conductivity (k-value) at 500 Degrees F (260 Degrees C) (ASTM C411, ASTM C518): 0.48 Btu/(ft<sup>2</sup> × h × F) (0.07 W/(m × K)).
  - v. R-Value per ASTM C 518 at ambient (77 F/ 25 C): at least 6.3 (F-ft<sup>2</sup>-hr / Btu)
  - vi. Service range up to 2000°F (1093°C)
  - vii. Fire Resistance: For use in 2 hour fire resistant systems.
  - viii. Product complies with ASTM E 2336 test standard.
  - ix. Product complies with ISO 6944 test standard.
  - x. Through-penetration per ASTM E 814 (UL 1479)
  - xi. Flame and smoke spread index of <25/<50
  - xii. Non-combustible per ASTM E 136
- b. 3M Fire Barrier Plenum Wrap 5A+: Lightweight, non-asbestos, high temperature, bio-soluble, calcium-magnesium-silicate (CMS) non-woven blanket, encapsulated in a scrim-reinforced foil, blanket thickness of 0.5 inches (13 mm) for protection of items within a plenum area.
  - i. Color: White blanket, aluminum foil encapsulated.
  - ii. Weight: 0.25 psf (1.22 kg/m<sup>2</sup>).
  - iii. Density: 6 pcf nominal.
  - iv. Thermal Conductivity (k-value) at 500 Degrees F (260 Degrees C) (ASTM C411, ASTM C518): 0.48 Btu/(ft<sup>2</sup> × h × F) (0.07 W/(m × K)).
  - v. Service range up to 2000°F (1093°C)
  - vi. Plenum Rating (electrical cables): Product complies with NFPA 262 (UL 910).
  - vii. Plenum Rating (non-metallic pipe): Product complies with UL 1887.
  - viii. Flame and smoke spread index of <25/<50
  - ix. Non-combustible per ASTM E 136.

Through-penetration firestop materials:

- i. Packing materials: Pieces of 3M Fire Barrier Duct Wrap, or 4 pcf mineral wool.
- ii. Sealants: 3M Fire Barrier Water Tight Sealant 1000 NS: non-slump silicone sealant, 1003 SL self-leveling silicone sealant, 3M Fire Barrier Sealant 2000+: non-slump silicone sealant, or CP 25WB+: high-performance, intumescent water-based sealant, as stated in firestop Design Listing.

## 2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.Eagle Bridges - Marathon Industries; 225.
    - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.Mon-Eco Industries, Inc.; 22-25.
  2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- C. FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
    - b. Eagle Bridges - Marathon Industries; 225.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.Mon-Eco Industries, Inc.; 22-25.
  2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
    - b. Vimasco Corporation; 749.
  2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
  3. Service Temperature Range: Minus 20 to plus 180 deg F.
  4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
  5. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
    - b. Eagle Bridges - Marathon Industries; 501.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
    - d. Mon-Eco Industries, Inc.; 55-10.
  2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
  3. Service Temperature Range: 0 to 180 deg F.
  4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
  5. Color: White.
- D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
    - b. Eagle Bridges - Marathon Industries; 570.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.
  2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.

3. Service Temperature Range: Minus 50 to plus 220 deg F.
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
  - b. Eagle Bridges - Marathon Industries; 550.
  - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
  - d. Mon-Eco Industries, Inc.; 55-50.
  - e. Vimasco Corporation; WC-1/WC-5.
2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

## 2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Products: Subject to compliance with requirements, provide one of the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
  - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
  - c. Vimasco Corporation; 713 and 714.
3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
4. Service Temperature Range: 0 to plus 180 deg F.
5. Color: White.

## 2.6 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
  - b. Eagle Bridges - Marathon Industries; 405.
  - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
  - d. Mon-Eco Industries, Inc.; 44-05.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."



**2.7 FACTORY-APPLIED JACKETS**

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

**2.8 FIELD-APPLIED FABRIC-REINFORCING MESH**

- A. Woven Glass-Fiber Fabric: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. in. for covering ducts.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas No. 5.
- B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for ducts.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.
    - b. Vimasco Corporation; Elastafab 894.

**2.9 FIELD-APPLIED CLOTHS**

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

**2.10 FIELD-APPLIED JACKETS**

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. Self-Adhesive Outdoor Jacket: 60-mil- thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with white aluminum-foil facing.
1. Products: Subject to compliance with requirements, provide the following:
    - a. Polyguard Products, Inc.; Alumaguard 60.

**2.11 TAPES**

- A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ABI, Ideal Tape Division; 491 AWF FSK.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
    - c. Compac Corporation; 110 and 111.
    - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

B. Duct Wrap Tape:

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. 3M; Fire Barrier Wrap Products.
  - b. Unifrax Corporation; FyreWrap.
  - c. CertainTeed Corp.; FlameChek
  - d. Johns Manville; Firetemp Wrap.
  - e. Nelson Fire Stop Products; Nelson FSB Flameshield Blanket.
  - f. Thermal Ceramics; FireMaster Duct Wrap
2. High performance filament tape, 3M No. 898 1 inch (25 mm) wide.
3. 3M FSK Facing Tape 3320 with aluminum foil, fiberglass scrim, kraft paper backing: nominal 3 inches (76 mm) or 4 inches (102 mm) wide (for sealing cut blanket edges and seams), 3M No. 3320.

**2.12 SECUREMENTS**

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. ITW Insulation Systems; Gerrard Strapping and Seals.
  - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal.
3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper or zinc coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-diameter shank, length to suit depth of insulation indicated.
  - a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) AGM Industries, Inc.; CWP-1.
    - 2) GEMCO; CD.
    - 3) Midwest Fasteners, Inc.; CD.
    - 4) Nelson Stud Welding; TPA, TPC, and TPS.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper or zinc coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
  - a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) AGM Industries, Inc.; CHP-1.
    - 2) GEMCO; Cupped Head Weld Pin.
    - 3) Midwest Fasteners, Inc.; Cupped Head.
    - 4) Nelson Stud Welding; CHP.
3. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

- a. Products: Subject to compliance with requirements, provide one of the following:
  - 1) AGM Industries, Inc.; RC-150.
  - 2) GEMCO; R-150.
  - 3) Midwest Fasteners, Inc.; WA-150.
  - 4) Nelson Stud Welding; Speed Clips.
- b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- D. Wire: 0.062-inch soft-annealed, stainless steel.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. C & F Wire.

## **2.13 CORNER ANGLES**

- A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
  - 1. Verify that systems to be insulated have been tested and are free of defects.
  - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

### **3.3 GENERAL INSTALLATION REQUIREMENTS**

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- A. Locate insulation and cover seams in the least visible location. All surface finishes shall be extended in such a manner as to protect all raw edges, ends and surfaces of insulation.
- B. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- C. Install multiple layers of insulation with longitudinal and end seams staggered.

- D. Keep insulation materials dry during application and finishing.
- E. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- F. Install insulation with least number of joints practical.
- G. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- H. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- I. Install insulation with factory-applied jackets as follows:
  - 1. Non self-sealing systems:
    - a. Draw jacket tight and smooth.
    - b. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
    - c. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
      - 1) For below ambient services, apply vapor-barrier mastic over staples.
    - d. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
    - e. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
  - 2. Self-sealing systems (ASJ+/SSL+ and ASJ/SSL):
    - a. Longitudinal jacketing lap joints for pipe insulation installed on piping systems with operating temperatures below ambient shall be vapor sealed with factory-applied pressure sensitive adhesive, vapor retarder self-sealing lap. For proper sealing, lap joints shall be sealed with reasonable pressure being applied with a plastic squeegee. All circumferential joints shall be vapor sealed with factory furnished matching, pressure sensitive butt strips installed with reasonable pressure being applied with a plastic squeegee. Additionally, raw ends of pipe insulation sections shall be coated with vapor retarder mastic at 12 foot intervals on straight piping and on either side of all fittings, flanges or valves. Vapor retarder mastic shall completely coat the ends of the pipe insulation and extend onto the bore of the pipe insulation and onto the jacketing a minimum of 2".
- J. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- K. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- L. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

### 3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.

4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
1. Comply with requirements in Section 078413 "Penetration Firestopping" firestopping and fire-resistive joint sealers.
- E. Insulation Installation at Floor Penetrations:
1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
  2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

### 3.5 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Install Duct Wrap using manufacturer's stretch-out tables to obtain specified R-value using a maximum compression of 25%.
  2. Minimum Installed R-value shall comply with the 2010 ASHRAE 90.1 and the 2009 International Energy Conservation Code, whichever is more stringent.
  3. Firmly butt all joints.
  4. The longitudinal seam of the vapor retarder must be overlapped a minimum of 2 inches.  
A 2-inch tab is provided on Knauf Friendly Feel® Duct Wrap for the circumferential seam. Secure all seams and overlaps using outward clinch staples approximately 6" on center. It is neither necessary nor desirable to adhere duct wrap to the duct surfaces with adhesive.
  5. Where vapor retarder performance is required, all penetrations and damage to the facing shall be repaired using pressure-sensitive tape matching the facing, or mastic prior to system startup. Pressure-sensitive tapes shall be a minimum 3 inches wide and shall be applied with moving pressure using a squeegee or other appropriate sealing tool. Closure shall have a 25/50 Flame Spread/Smoke Developed Rating per UL 723.
  6. Duct Wrap shall be additionally secured to the bottom of rectangular ductwork over 24 inches wide using mechanical fasteners on 18-inch centers. Care should be exercised to avoid over-compression of the insulation during installation. Unfaced Duct Wrap shall be overlapped a minimum of 2 inches and fastened using 4-inch to 6-inch nails or skewers spaced 4 inches apart, or secured with a wire/banding system. Care should be exercised to avoid damage to the Duct Wrap.
  7. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.

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- a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
  - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
  - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
  - d. Do not overcompress insulation during installation.
  - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
10. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
- a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
  - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
11. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
12. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

### **3.2 FIELD-APPLIED JACKET INSTALLATION**

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
  2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
  3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
1. Draw jacket material smooth and tight.
  2. Install lap or joint strips with same material as jacket.
  3. Secure jacket to insulation with manufacturer's recommended adhesive.
  4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
  5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

### **3.3 FIRE-RATED INSULATION SYSTEM INSTALLATION**

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.
- C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 078413 "Penetration Firestopping."
- D. Fire Rated Duct Wrap Insulation (1 and 2 HR. Enclosures)

1. Ventilation Air Ducts (1 and 2 hr. Enclosure): Install fire-resistive duct wrap insulation in direct contact with ductwork to Manufacturer's instructions and referenced standards, including Listed penetration firestop system.
  - i. Apply fire-resistive duct wrap insulation continuously to ductwork as indicated on Drawings. For ventilation air ducts, provide one layer of 3M Fire Barrier Duct Wrap 615+ with 3 inch (76 mm) overlaps for 1 and 2 hour applications. Observe requirements for additional duct wrap material required at firestop, when required.
2. Ventilation Ductwork (1 and 2 hr. applications): overlap perimeter and longitudinal joints 3 inches (76 mm). If required, tape seams using minimum 3 inch (76 mm) wide aluminium foil adhesive tape.
3. Filament tape may be used as a temporary securing measure during application of duct wrap. Finish installation using 1/2 inch (13 mm) wide by 0.015 inch (0.4 mm) steel banding on exterior layer of wrap. Spacing 10.5 inches (267 mm) on center and within 1.5 inches (39 mm) of all overlapped seams. Consult individual listings for approved banding type.
4. Duct Widths Greater than 24 Inches (610 mm): Weld insulation pins to bottom of horizontal ducts on a 12 inch (305 mm) by 10.5 inch (267 mm) maximum grid spacing. Welded insulation pins to one of the wider sides of all vertical ducts on a 12 inch (305 mm) by 10.5 inch (267 mm) maximum grid spacing. Impale duct wrap insulation over pins and secure with speed clips.
5. Duct Access Doors: Install duct wrap to Manufacturer's instructions and procedures.
6. Firestopping At Fire Separations:
  - i. Firestop all wrapped ductwork penetrating fire rated concrete floors, gypsum board, block and concrete wall assemblies and gypsum board shaft wall assemblies using UL and/or Intertek firestop system Listings appropriate for the applicable duct wrap system .
  - ii. Ventilation ducts: Fire resistive insulation may pass continuously through fire rated wall or floor penetrations or may tightly butt to both sides of fire rated separations. Minimum 1 inch (25 mm), maximum 3 inch (76 mm) clearance permitted around unwrapped duct in opening or from edge of opening to outer layer of duct wrap. Consult individual Listed firestop systems for specific requirements.
    - a. Option A: Terminate wrap at fire separation. Fill space around unwrapped duct where it passes through a fire-rated wall or floor with pieces of 3M duct wrap insulation or mineral wool insulation firmly packed into opening. Compress to the percentage stated in the firestop listing to full depth of floor or wall. Recess packing on both sides of walls or top side of floor to depth stated in firestop listing. Seal over packing material using 3M Fire Barrier Sealant to depth stated in firestop listing, flush with top side of floor and both sides of wall surfaces. Tightly butt fire resistive duct wrap insulation to each side of wall or floor assembly and seal interface with a continuous bead of 3M Fire Barrier Sealant.
    - b. Option B: Wrap continuous through fire separation. Fill space around continuously wrapped duct where it passes through fire rated wall or floor with pieces of 3M duct wrap insulation or mineral wool insulation firmly packed into opening and compress to the percentage stated in the firestop listing to a minimum depth of 4 inches (102 mm). Recess packing material below surface on both sides of wall or top side of floor to depth stated in firestop listing. Seal over packing material using 3M Fire Barrier Sealant to depth stated in firestop listing, flush with top side of floor and both sides of wall surfaces.

### 3.4 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 Section "Exterior Painting" and Division 09 Section "Interior Painting."



1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

- a. Finish Coat Material: Interior, flat, latex-emulsion size.

- B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

- C. Do not field paint FSK jackets.

### 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

- B. Tests and Inspections:

1. Inspect ductwork, randomly selected by the Commissioning Authority, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each duct system defined in the "Duct Insulation Schedule, General" Article.

- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### 3.6 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
  2. Indoor, exposed supply and outdoor air.
  3. Indoor, concealed return located in unconditioned space.
  4. Indoor, exposed return located in unconditioned space.
  5. Indoor, concealed oven and warewash exhaust.
  6. Indoor, exposed oven and warewash exhaust.
  7. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
  8. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
  9. Outdoor, concealed supply and return.
  10. Outdoor, exposed supply and return.

- B. Items Not Insulated:

1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
  2. Factory-insulated flexible ducts.
  3. Factory-insulated plenums and casings.
  4. Flexible connectors.
  5. Vibration-control devices.
  6. Factory-insulated access panels and doors.

### 3.7 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, round and flat-oval, supply-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2-3/8 inches thick and 0.75-lb/cu. ft. nominal density (R-6).

- B. Concealed, round and flat-oval, return-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2-3/8 inches thick and 0.75-lb/cu. ft. nominal density (R-6).
  2. No insulation required if ductwork is located in a ceiling return plenum.

- C. Concealed, round and flat-oval, outdoor-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 3 inches thick and 0.75-lb/cu. ft. nominal density (R-8).

- D. Concealed, round and flat-oval, exhaust-air duct insulation between isolation damper and penetration of building exterior shall be the following:
1. Mineral-Fiber Blanket: 3 inches thick and 0.75-lb/cu. ft. nominal density (R-8).
  2. No insulation required if ductwork is located upstream of the isolation damper.
- E. Concealed, rectangular, supply-air duct insulation shall be the following:
1. Mineral-Fiber Blanket: 2-3/8 inches thick and 0.75-lb/cu. ft. nominal density (R-6).
- F. Concealed, rectangular, return-air duct insulation shall be the following:
1. Mineral-Fiber Blanket: 2-3/8 inches thick and 0.75-lb/cu. ft. nominal density (R-6).
  2. No insulation required if ductwork is located in a ceiling return plenum.
- G. Concealed, rectangular, outdoor-air duct insulation shall be the following:
1. Mineral-Fiber Blanket: 3 inches thick and 0.75-lb/cu. ft. nominal density (R-8).
- H. Concealed, rectangular, exhaust-air duct insulation between isolation damper and penetration of building exterior shall be the following:
1. Mineral-Fiber Blanket: 3 inches thick and 0.75-lb/cu. ft. nominal density (R-8).
  2. No insulation required if ductwork is located upstream of the isolation damper.
- I. Concealed, supply-air plenum insulation shall be the following:
1. Mineral-Fiber Blanket: 2-3/8 inches thick and 0.75-lb/cu. ft. nominal density (R-6).
- J. Concealed, return-air plenum insulation shall be the following:
1. Mineral-Fiber Blanket: 2-3/8 inches thick and 0.75-lb/cu. ft. nominal density (R-6).
- K. Concealed, outdoor-air plenum insulation shall be the following:
1. Mineral-Fiber Blanket: 3 inches thick and 0.75-lb/cu. ft. nominal density (R-8).
- L. Concealed, exhaust-air plenum insulation shall be the following:
1. Mineral-Fiber Blanket: 3 inches thick and 0.75-lb/cu. ft. nominal density (R-8).
- M. Exposed, round and flat-oval, supply-air duct insulation shall be the following:
1. In mechanical rooms and service areas, use mineral-Fiber Blanket: 2-3/8 inches thick and 0.75-lb/cu. ft. nominal density (R-6).
  2. In finished spaces, exposed spiral round and flat-oval ductwork shall be internally acoustically lined and provided with perforated inner wall, with internal liner thickness as required to provide R-6.
- N. Exposed, round and flat-oval, return-air duct insulation shall be the following:
1. In mechanical rooms and service areas, use mineral-Fiber Blanket: 2-3/8 inches thick and 0.75-lb/cu. ft. nominal density (R-6).
  2. No insulation required for return ductwork running through air-conditioned spaces.
- O. Exposed, round and flat-oval, outdoor-air duct insulation shall be the following:
1. In mechanical rooms and service areas, use mineral-Fiber Blanket: 3 inches thick and 0.75-lb/cu. ft. nominal density (R-8).
  2. In finished spaces, exposed spiral round and flat-oval ductwork shall be internally acoustically lined and provided with perforated inner wall, with internal liner thickness as required to provide R-8.
- P. Exposed, round and flat-oval, exhaust-air duct insulation between isolation damper and penetration of building exterior shall be the following:
1. In mechanical rooms and service areas, use mineral-Fiber Blanket: 3 inches thick and 0.75-lb/cu. ft. nominal density (R-8).
  2. No insulation required for exhaust ductwork upstream of isolation damper.
- Q. Exposed, rectangular, supply-air duct insulation shall be the following:
1. In mechanical rooms and service areas, use mineral-Fiber Board: 2 inches thick and 1-1/2-lb/cu. ft. nominal density (R-6).
  2. In finished spaces, exposed ductwork shall be internally acoustically lined, thickness as required to provide R-6.

- R. Exposed, rectangular, return-air duct insulation shall be the following:
1. In mechanical rooms and service areas, use mineral-Fiber Board: 2 inches thick and 1-1/2-lb/cu. ft. nominal density (R-6).
  2. No insulation required for return ductwork running through air-conditioned spaces.
- S. Exposed, rectangular, outdoor-air duct insulation shall be the following:
1. In mechanical rooms and service areas, use mineral-Fiber Board: 3 inches thick and 1-1/2-lb/cu. ft. nominal density (R-8).
  2. In finished spaces, exposed ductwork shall be internally acoustically lined, thickness as required to provide R-8.
- T. Exposed, rectangular, exhaust-air duct insulation between isolation damper and penetration of building exterior shall be the following:
1. Mineral-Fiber Board: 3 inches thick and 1-1/2-lb/cu. ft. nominal density (R-8).
  2. No insulation required for exhaust ductwork upstream of isolation damper.
- U. Exposed, supply-air plenum insulation shall be the following:
1. Mineral-Fiber Board: 2 inches thick and 1-1/2-lb/cu. ft. nominal density (R-6).
- V. Exposed, return-air plenum insulation shall be the following:
1. Mineral-Fiber Board: 2 inches thick and 1-1/2-lb/cu. ft. nominal density (R-6).
- W. Exposed, outdoor-air plenum insulation shall be the following:
1. Mineral-Fiber Board: 2 inches thick and 1-1/2 lb/cu. ft. nominal density (R-8).
- X. Exposed, exhaust-air plenum insulation shall be the following:
1. Mineral-Fiber Board: 3 inches thick and 1-1/2-lb/cu. ft. nominal density (R-8).

### 3.8 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, rectangular, supply, return, outside air intake, and exhaust duct insulation shall be the following:
1. Mineral-Fiber Board: 3 inches thick and 1-1/2 lb/cu. Ft. nominal density (R-8).
- B. Exposed, rectangular, supply, return, outside air intake, and exhaust duct insulation shall be the following:
1. Mineral-Fiber Board: 3 inches thick and 1-1/2-lb/cu. Ft. nominal density (R-8).
- C. Insulation on top of rectangular ductwork shall pitch from high point at the center to each side, to avoid trapping of water in the center. Maintain minimum insulation thickness at all surfaces.

#### ASHRAE 90.1 – 2010 REQUIREMENTS – DUCT INSULATION

Minimum Duct Insulation R-Value <sup>a</sup> , Combined Heating and Cooling Supply Ducts and Return Ducts							
Duct Location							
Climate Zone	Exterior	Ventilated Attic	Unvented Attic Above Insulated Ceiling	Unvented Attic with Roof Insulation <sup>a</sup>	Unconditioned Space <sup>b</sup>	Indirectly Conditioned Space <sup>c</sup>	Buried
Supply Ducts							
1	R-6.0	R-6.0	R-8.0	R-3.5	R-3.5	None	R-3.5
2	R-6.0	R-6.0	R-6.0	R-3.5	R-3.5	None	R-3.5
3	R-6.0	R-6.0	R-6.0	R-3.5	R-3.5	None	R-3.5
4	R-6.0	R-6.0	R-6.0	R-3.5	R-3.5	None	R-3.5
5	R-6.0	R-6.0	R-6.0	R-1.9	R-3.5	None	R-3.5
6	R-8.0	R-6.0	R-6.0	R-1.9	R-3.5	None	R-3.5
7	R-8.0	R-6.0	R-6.0	R-1.9	R-3.5	None	R-3.5
8	R-8.0	R-8.0	R-8.0	R-1.9	R-6.0	None	R-6.0
Return Ducts							
1 thru 8	R-3.5	R-3.5	R-3.5	None	None	None	None

Where insulation R-values in this table are different from R-values specified in other articles, the most stringent requirement shall apply.

<sup>a</sup> Insulation R – values, measured in (hr· ft<sup>2</sup>· °F)/Btu, are for the insulation as installed and do not include film resistance. The required minimum thicknesses do not consider water vapor transmission and possible surface condensation. Where exterior walls are used as plenum walls, wall insulation shall be required by the most restrictive condition of Section 6.4.4.2 or Section 5. Insulation resistance measured on a horizontal plane in accordance with ASTM C518 at a Mean temperature of 75° F at the installed thickness.

<sup>b</sup> Includes crawlspaces, both ventilated and non-ventilated.

<sup>c</sup> Includes return air plenum with or without exposed roofs above.

### **3.9 INDOOR, FIELD-APPLIED JACKET SCHEDULE**

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Ducts and Plenums, Concealed:
  - 1. None.
- D. Ducts and Plenums, Exposed :
  - 1. None.

### **3.10 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE**

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Ducts and Plenums, Concealed:
  - 1. Apply two coats of weatherproof mastic and embed into wet coat two layers of glass cloth over insulation jacket. Smooth membrane to avoid wrinkles and overlap all seams at least 3 inches. Apply a second coat of the same coating to the entire surface.
  - 2. Polyguard Alumaguard 60.
- D. Ducts and Plenums, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:
  - 1. Apply two coats of weatherproof mastic and embed into wet coat two layers of glass cloth over insulation jacket. Smooth membrane to avoid wrinkles and overlap all seams at least 3 inches. Apply a second coat of the same coating to the entire surface.
  - 2. Polyguard Alumaguard 60.
- E. Ducts and Plenums, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:
  - 1. Apply two coats of weatherproof mastic and embed into wet coat two layers of glass cloth over insulation jacket. Smooth membrane to avoid wrinkles and overlap all seams at least 3 inches. Apply a second coat of the same coating to the entire surface.
  - 2. Polyguard Alumaguard 60.

**END OF SECTION 230713**

## **SECTION 230716 - HVAC EQUIPMENT INSULATION**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section includes insulating the following HVAC equipment that is not factory insulated:
  - 1. Geothermal (Glycol) water pumps.
  - 2. Expansion & Storage tanks.
  - 3. Air separators.
  - 4. Heat exchangers.
- B. Related Sections:
  - 1. Division 23 Section "Duct Insulation."
  - 2. Division 23 Section "HVAC Piping Insulation."

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail attachment and covering of heat tracing inside insulation.
  - 3. Detail removable insulation at equipment connections.
  - 4. Detail application of field-applied jackets.
  - 5. Detail application at linkages of control devices.
  - 6. Detail field application for each equipment type.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

#### **1.5 QUALITY ASSURANCE**

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

**1.7 COORDINATION**

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with equipment Installer for equipment insulation application.
- C. Coordinate installation and testing of heat tracing.

**1.8 SCHEDULING**

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

**PART 2 - PRODUCTS**

**2.1 INSULATION MATERIALS**

- A. Comply with requirements in "Breeching Insulation Schedule" and "Equipment Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Calcium Silicate:
  - 1. Products: Subject to compliance with requirements provide one of the following:
    - a. Industrial Insulation Group (IIG); Thermo-12 Gold.
  - 2. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
- G. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Products: Subject to compliance with requirements, provide the following provide one of the following:
    - a. Pittsburgh Corning Corporation; Foamglas.
    - b. CertainTeed Corporation.
    - c. Johns Manville.
  - 2. Block Insulation: ASTM C 552, Type I..
  - 3. Special-Shaped Insulation: ASTM C 552, Type III.
  - 4. Board Insulation: ASTM C 552, Type IV.

5. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. Provide insulation with factory-applied ASJ jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; CertaPro Commercial Board.
    - b. Fibrex Insulations Inc.; FBX.
    - c. Johns Manville; 800 Series Spin-Glas.
    - d. Knauf Insulation; Insulation Board.
    - e. Manson Insulation Inc.; AK Board.
    - f. Owens Corning; Fiberglas 700 Series.
- I. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; CrimpWrap.
    - b. Johns Manville; MicroFlex.
    - c. Knauf Insulation; Pipe and Tank Insulation.
    - d. Manson Insulation Inc.; AK Flex.
    - e. Owens Corning; Fiberglas Pipe and Tank Insulation.

## **2.2 INSULATING CEMENTS**

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Ramco Insulation, Inc.; Super-Stik.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Ramco Insulation, Inc.; Thermokote V.
- C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

## **2.3 ADHESIVES**

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F.
  1. Products: Subject to compliance with requirements, provide one of the following:

- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-97.
    - b. - Marathon Industries; 290.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-27.
    - d. Mon-Eco Industries, Inc.; 22-30.
    - e. Vimasco Corporation; 760.
  2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84.
  2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
    - b. - Marathon Industries; 225.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
    - d. Mon-Eco Industries, Inc.; 22-25.
  2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
    - b. - Marathon Industries; 225.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
    - d. Mon-Eco Industries, Inc.; 22-25.
  2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
  4. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).



5. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## **2.4 MASTICS**

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Foster Brand, Specialty Construction Brands, Inc., a business of H .B. Fuller Company; 30-80/30-90.
  - b. Vimasco Corporation; 749.
2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
  - b. - Marathon Industries; 501.
  - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
  - d. Mon-Eco Industries, Inc.; 55-10.
2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
3. Service Temperature Range: 0 to 180 deg F.
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

- D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
  - b. - Marathon Industries; 570.
  - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.
2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F.
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

- E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
  - b. - Marathon Industries; 550.
  - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
  - d. Mon-Eco Industries, Inc.; 55-50.

- e. Vimasco Corporation; WC-1/WC-5.
- 2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
- 3. Service Temperature Range: Minus 20 to plus 180 deg F.
- 4. Solids Content: 60 percent by volume and 66 percent by weight.
- 5. Color: White.

## 2.5 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
  - 1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
    - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
    - c. Vimasco Corporation; 713 and 714.
  - 3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment insulation.
  - 4. Service Temperature Range: 0 to plus 180 deg F.
  - 5. Color: White.

## 2.6 SEALANTS

- A. Joint Sealants:
  - 1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
    - b. - Marathon Industries; 405.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
    - d. Mon-Eco Industries, Inc.; 44-05.
    - e. Pittsburgh Corning Corporation; Pittseal 444.
  - 2. Joint Sealants for Polystyrene Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-70.
    - b. - Marathon Industries; 405.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
    - d. Mon-Eco Industries, Inc.; 44-05.
  - 3. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 4. Permanently flexible, elastomeric sealant.
  - 5. Service Temperature Range: Minus 100 to plus 300 deg F.
  - 6. Color: White or gray.
  - 7. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 8. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
  - b. - Marathon Industries; 405.
  - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
  - d. Mon-Eco Industries, Inc.; 44-05.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

**2.7 FACTORY-APPLIED JACKETS**

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
  2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
  3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
  4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.

**2.8 FIELD-APPLIED FABRIC-REINFORCING MESH**

- A. Woven Glass-Fiber Fabric: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. in. for covering equipment.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas No. 5.
- B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for equipment.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.
  - b. Vimasco Corporation; Elastafab 894.

## **2.9 FIELD-APPLIED CLOTHS**

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

## **2.10 FIELD-APPLIED JACKETS**

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Johns Manville; Zeston.
    - b. P.I.C. Plastics, Inc.; FG Series.
    - c. Proto Corporation; LoSmoke.
    - d. Speedline Corporation; SmokeSafe.
  2. Adhesive: As recommended by jacket material manufacturer.
  3. Color: White.
  4. Factory-fabricated tank heads and tank side panels.
- D. Metal Jacket:
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
    - b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
    - c. RPR Products, Inc.; Insul-Mate.
  2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
    - a. Factory cut and rolled to size.
    - b. Finish and thickness are indicated in field-applied jacket schedules.
    - c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
    - d. Moisture Barrier for Outdoor Applications: 2.5-mil- thick polysurlyn.
    - e. Factory-Fabricated Fitting Covers:
      - 1) Same material, finish, and thickness as jacket.
      - 2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      - 3) Tee covers.
      - 4) Flange and union covers.
      - 5) End caps.
      - 6) Beveled collars.
      - 7) Valve covers.

- 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
    - a. Factory cut and rolled to size.
    - b. Material, finish, and thickness are indicated in field-applied jacket schedules.
    - c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
    - d. Moisture Barrier for Outdoor Applications: 2.5-mil- thick polysurlyn.
    - e. Factory-Fabricated Fitting Covers:
      - 1) Same material, finish, and thickness as jacket.
      - 2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      - 3) Tee covers.
      - 4) Flange and union covers.
      - 5) End caps.
      - 6) Beveled collars.
      - 7) Valve covers.
      - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
- E. Self-Adhesive Outdoor Jacket: 60-mil- thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with white aluminum-foil facing.
1. Products: Subject to compliance with requirements, provide the following:
    - a. Polyguard Products, Inc.; Alumaguard 60.

## 2.11 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ABI, Ideal Tape Division; 428 AWF ASJ.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
    - c. Compac Corporation; 104 and 105.
    - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
  2. Width: 3 inches.
  3. Thickness: 11.5 mils.
  4. Adhesion: 90 ounces force/inch in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch in width.
  7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ABI, Ideal Tape Division; 491 AWF FSK.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
    - c. Compac Corporation; 110 and 111.
    - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
  2. Width: 3 inches.
  3. Thickness: 6.5 mils.
  4. Adhesion: 90 ounces force/inch in width.
  5. Elongation: 2 percent.

6. Tensile Strength: 40 lbf/inch in width.
  7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ABI, Ideal Tape Division; 370 White PVC tape.
    - b. Compac Corporation; 130.
    - c. Venture Tape; 1506 CW NS.
  2. Width: 2 inches.
  3. Thickness: 6 mils.
  4. Adhesion: 64 ounces force/inch in width.
  5. Elongation: 500 percent.
  6. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ABI, Ideal Tape Division; 488 AWF.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
    - c. Compac Corporation; 120.
    - d. Venture Tape; 3520 CW.
  2. Width: 2 inches.
  3. Thickness: 3.7 mils.
  4. Adhesion: 100 ounces force/inch in width.
  5. Elongation: 5 percent.
  6. Tensile Strength: 34 lbf/inch in width.

## **2.12 SECUREMENTS**

- A. Bands:
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ITW Insulation Systems; Gerrard Strapping and Seals.
    - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
  2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 316; 0.015 inch thick, 3/4 inch wide with wing seal.
  3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal .
- B. Insulation Pins and Hangers:
1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch diameter shank, length to suit depth of insulation indicated.
    - a. Products: Subject to compliance with requirements, provide one of the following]:
      - 1) AGM Industries, Inc.; CWP-1.
      - 2) GEMCO; CD.
      - 3) Midwest Fasteners, Inc.; CD.
      - 4) Nelson Stud Welding; TPA, TPC, and TPS.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
  - a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) AGM Industries, Inc.; CHP-1.
    - 2) GEMCO; Cupped Head Weld Pin.
    - 3) Midwest Fasteners, Inc.; Cupped Head.
    - 4) Nelson Stud Welding; CHP.
3. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
  - a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) AGM Industries, Inc.; RC-150.
    - 2) GEMCO; R-150.
    - 3) Midwest Fasteners, Inc.; WA-150.
    - 4) Nelson Stud Welding; Speed Clips.
  - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- D. Wire: 0.062-inch soft-annealed, stainless steel.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. C & F Wire.

## **2.13 CORNER ANGLES**

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.
- C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 316.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
  1. Verify that systems and equipment to be insulated have been tested and are free of defects.
  2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
  - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
  - 2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

### **3.3 GENERAL INSTALLATION REQUIREMENTS**

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.



2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- O. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
  2. Testing agency labels and stamps.
  3. Nameplates and data plates.
  4. Manholes.
  5. Handholes.
  6. Cleanouts.

### **3.4 INSTALLATION OF EQUIPMENT, TANK, AND VESSEL INSULATION**

- A. Mineral-Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with bands, anchor pins, and speed washers.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces, unless otherwise indicated by insulation manufacturer in writing, with this documentation submitted to the engineer for review and approval.
  2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
  3. Protect exposed corners with secured corner angles.
  4. Install insulation hangers and speed washers on sides of tanks and vessels as follows:
    - a. Do not weld anchor pins to ASME-labeled pressure vessels – use bands and adhesives.
    - b. Weld pins may be used for non-ASME-labeled equipment, subject to manufacturer's approval.
    - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 12 inches o.c. in both directions.
    - d. Do not overcompress insulation during installation.
    - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
    - f. Impale insulation over anchor pins and attach speed washers.
    - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
  6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or

- cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches.
  8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
  9. Install removable jackets for plate and frame heat exchangers.
  10. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
  11. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Insulation Installation on Pumps:

1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch- diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
2. Fabricate boxes from galvanized steel, at least 0.050 inch thick.
3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.
4. . Apply finish coat of lagging adhesive over glass cloth. Thin finish coat to achieve smooth, uniform finish.

### 3.5 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

### 3.6 FINISHES

A. Equipment Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 Section "Exterior Painting" and Division 09 Section "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

- a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- C. Do not field paint aluminum or stainless-steel jackets.

### **3.7 FIELD QUALITY CONTROL**

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections: Inspect field-insulated equipment, randomly selected by the Commissioning Authority, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### **3.8 EQUIPMENT INSULATION SCHEDULE**

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.
- B. Insulate indoor and outdoor equipment that is not factory insulated.
- C. Geothermal and Heating-hot-water pump insulation shall be the following:
  - 1. Cellular Glass: 2 inches thick, factory applied jacket.
- D. Geothermal and Heating-water expansion/compression tank, air separator and heat exchangers insulation shall be the following:
  - 1. Cellular Glass: 2 inches thick, factory applied jacket.

### **3.9 INDOOR, FIELD-APPLIED JACKET SCHEDULE**

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Equipment, Concealed:
  - 1. None.
- D. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:
  - 1. PVC,: 30 mils thick.
- E. Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:
  - 1. Aluminum, with 1-1/4-Inch- Deep Corrugations: 0.032 inch thick.

**END OF SECTION 230716**

**SECTION 230719 - HVAC PIPING INSULATION**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Furnish and install thermal insulation as specified herein and as indicated on the drawings.
- B. Section includes insulating the following HVAC piping systems:
  - 1. Condensate drain piping, indoors and outdoors.
  - 2. Geothermal condenser water piping, indoors and outdoors
  - 3. Heating hot-water piping, indoors and outdoors.
  - 4. Refrigerant suction and hot-gas piping, indoors and outdoors.
- C. Related Sections:
  - 1. Division 23 Section "Duct Insulation."
  - 2. Division 23 Section "HVAC Equipment Insulation."

**1.3 REFERENCE STANDARDS**

- A. All equipment and material to be furnished and installed shall be UL or ETL listed in accordance with the requirements of the authorities having jurisdiction and suitable for its intended use.
- B. All thermal insulation shall be designed, manufactured and tested in accordance with the following latest applicable standards.
  - 1. ASTM B209, ASTM C591, ASTM C1136, ASTM C755, ASTM C34, ASTM C177, ASTM C355, ASTM C533, ASTM C547, ASTM C552, ASTM E84 and ASTM E96.
  - 2. UL 723.
  - 3. ADA.
  - 4. NFPA 225.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Mechanical Contractor shall submit product data including materials, thermal properties, adhesives and installation details.
  - 2. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.

3. Detail attachment and covering of heat tracing inside insulation.
4. Detail insulation application at pipe expansion joints for each type of insulation.
5. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
6. Detail removable insulation at piping specialties.
7. Detail application of field-applied jackets.
8. Detail application at linkages of control devices.

#### **1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

#### **1.6 QUALITY ASSURANCE**

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
  1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

#### **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

#### **1.8 COORDINATION**

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

#### **1.9 SCHEDULING**

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

## **PART 2 - PRODUCTS**

### **2.1 INSULATION MATERIALS**

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," and "Outdoor, Aboveground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Mineral-Fiber, Preformed Pipe Insulation:
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Fibrex Insulations Inc.; Coreplus 1200.
    - b. Johns Manville; Micro-Lok.
    - c. Knauf Insulation; 1000-Degree Pipe Insulation.
    - d. Manson Insulation Inc.; Alley-K.
    - e. Owens Corning; Fiberglas Pipe Insulation.
  - 2. Type I, 850 deg F (454 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

### **2.2 INSULATING CEMENTS**

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Ramco Insulation, Inc.; Super-Stik.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Ramco Insulation, Inc.; Thermokote V.
- C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

## 2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
  - 1. Products: Subject to compliance with requirements, [provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
    - b. - Marathon Industries; 225.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
    - d. Mon-Eco Industries, Inc.; 22-25.
  - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. PVC Jacket Adhesive: Compatible with PVC jacket.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Corning Corporation; 739, Dow Silicone.
    - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
    - c. P.I.C. Plastics, Inc.; Welding Adhesive.
    - d. Speedline Corporation; Polyco VP Adhesive.
  - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
  - 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

1. Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:
    - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
    - b. Vimasco Corporation; 749.
  2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
  3. Service Temperature Range: Minus 20 to plus 180 deg F.
  4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
  5. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.
1. Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
    - b. Marathon Industries; 501.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
    - d. Mon-Eco Industries, Inc.; 55-10.
  2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
  3. Service Temperature Range: 0 to 180 deg F.
  4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
  5. Color: White.
- D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.
1. Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
    - b. - Marathon Industries; 570.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.



2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
  3. Service Temperature Range: Minus 50 to plus 220 deg F.
  4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
  5. Color: White.
- E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
    - b. Marathon Industries; 550.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
    - d. Mon-Eco Industries, Inc.; 55-50.
    - e. Vimasco Corporation; WC-1/WC-5.
  2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
  3. Service Temperature Range: Minus 20 to plus 180 deg F.
  4. Solids Content: 60 percent by volume and 66 percent by weight.
  5. Color: White.
- 2.5 LAGGING ADHESIVES**
- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  2. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
    - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
    - c. Vimasco Corporation; 713 and 714.
  3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.

4. Service Temperature Range: 0 to plus 180 deg F.
5. Color: White.

**2.6 SEALANTS**

**A. Joint Sealants:**

1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products: Subject to compliance with requirements, provide one of the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
  - b. Marathon Industries; 405.
  - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
  - d. Mon-Eco Industries, Inc.; 44-05.
  - e. Pittsburgh Corning Corporation; Pittseal 444.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Color: White or gray.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

**B. FSK and Metal Jacket Flashing Sealants:**

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
  - b. Marathon Industries; 405.
  - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
  - d. Mon-Eco Industries, Inc.; 44-05.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.

4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

**2.7 FACTORY-APPLIED JACKETS**

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
  2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
  3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
  4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.

5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

**2.8 FIELD-APPLIED FABRIC-REINFORCING MESH**

- A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas Number 10.
- B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.
    - b. Vimasco Corporation; Elastafab 894.

**2.9 FIELD-APPLIED CLOTHS**

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

**2.10 FIELD-APPLIED JACKETS**

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Johns Manville; Zeston.
    - b. P.I.C. Plastics, Inc.; FG Series.
    - c. Proto Corporation; LoSmoke.
    - d. Speedline Corporation; SmokeSafe.
  2. Adhesive: As recommended by jacket material manufacturer.
  3. Color: White.

4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

- a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

D. Metal Jacket:

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
- b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
- c. RPR Products, Inc.; Insul-Mate.

2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

- a. Sheet and roll stock ready for shop or field sizing.
- b. Finish and thickness are indicated in field-applied jacket schedules.
- c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
- d. Moisture Barrier for Outdoor Applications: 2.5-mil- thick polysurlyn.
- e. Factory-Fabricated Fitting Covers:
  - 1) Same material, finish, and thickness as jacket.
  - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
  - 3) Tee covers.
  - 4) Flange and union covers.
  - 5) End caps.
  - 6) Beveled collars.
  - 7) Valve covers.
  - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

E. Self-Adhesive Outdoor Jacket: 60-mil- thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with white aluminum-foil facing.

1. Products: Subject to compliance with requirements, provide the following:

- a. Polyguard Products, Inc.; Alumaguard 60.

**2.11 TAPES**

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. ABI, Ideal Tape Division; 428 AWF ASJ.
- b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
- c. Compac Corporation; 104 and 105.

- d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
    - e. <Insert manufacturer's name; product name or designation>.
  - 2. Width: 3 inches.
  - 3. Thickness: 11.5 mils.
  - 4. Adhesion: 90 ounces force/inch in width.
  - 5. Elongation: 2 percent.
  - 6. Tensile Strength: 40 lbf/inch in width.
  - 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ABI, Ideal Tape Division; 491 AWF FSK.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
    - c. Compac Corporation; 110 and 111.
    - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
  - 2. Width: 3 inches.
  - 3. Thickness: 6.5 mils.
  - 4. Adhesion: 90 ounces force/inch in width.
  - 5. Elongation: 2 percent.
  - 6. Tensile Strength: 40 lbf/inch in width.
  - 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ABI, Ideal Tape Division; 370 White PVC tape.
    - b. Compac Corporation; 130.
    - c. Venture Tape; 1506 CW NS.
  - 2. Width: 2 inches.

3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. ABI, Ideal Tape Division; 488 AWF.
  - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
  - c. Compac Corporation; 120.
  - d. Venture Tape; 3520 CW.
2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

## **2.12 SECUREMENTS**

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. ITW Insulation Systems; Gerrard Strapping and Seals.
  - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

C. Wire: 0.062-inch soft-annealed, stainless steel.

1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
  - a. C & F Wire.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
  - 1. Verify that systems to be insulated have been tested and are free of defects.
  - 2. Verify that surfaces to be insulated are clean and dry.
  - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 PREPARATION**

- A. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
  - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
  - 2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

**3.3 GENERAL INSTALLATION REQUIREMENTS**

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.



- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
    - a. For below-ambient services, apply vapor-barrier mastic over staples.
  - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
  - 1. Vibration-control devices.
  - 2. Testing agency labels and stamps.
  - 3. Nameplates and data plates.
  - 4. Manholes.
  - 5. Handholes.
  - 6. Cleanouts.

### **3.4 PENETRATIONS**

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  - 4. Seal jacket to wall flashing with flashing sealant.

- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
  - 1. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
  - 1. Pipe: Install insulation continuously through floor penetrations.
  - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

### **3.5 GENERAL PIPE INSULATION INSTALLATION**

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
  - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
  - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
  - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
  - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
  - 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable

- insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
  7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
  9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
  2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
  3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
  4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
  5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

**3.6 INSTALLATION OF MINERAL-FIBER INSULATION**

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

4. Install insulation to flanges as specified for flange insulation application.

### **3.7 FIELD-APPLIED JACKET INSTALLATION**

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
  1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
  2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
  3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
  1. Draw jacket material smooth and tight.
  2. Install lap or joint strips with same material as jacket.
  3. Secure jacket to insulation with manufacturer's recommended adhesive.
  4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
  5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.
  1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

### **3.8 FINISHES**

- A. Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 Section "Exterior Painting" and Division 09 Section "Interior Painting."
  1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

**3.9 FIELD QUALITY CONTROL**

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
  - 1. Inspect pipe, fittings, strainers, and valves, randomly selected by the Commissioning Authority, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

**3.10 PIPING INSULATION SCHEDULE, GENERAL**

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
  - 1. Drainage piping located in crawl spaces.
  - 2. Underground piping.
  - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

**3.11 INDOOR PIPING INSULATION SCHEDULE**

- A. Hot Water and Geothermal Condenser Water Supply and Return:
  - 1. NPS 1-1/4 and Smaller: Insulation shall be the following:
    - a. Mineral Fiber: 1-1/2 inches thick, factory applied jacket.
  - 2. NPS 1-1/2 and Larger: Insulation shall be the following:
    - a. Mineral Fiber: 2 inches thick, factory applied jacket.
- B. Refrigerant Suction and Liquid:
  - 1. All Pipe Sizes: Insulation shall be one of the following:
    - a. Mineral Fiber: 1 inch thick, factory applied jacket.
    - b. Closed Cell Elastomer: 1 inch thick.
- C. Condensate Drain:

1. All Pipe Sizes: Insulation shall be the following:

- a. Mineral Fiber: 1 inch thick, factory applied jacket.

- D. For piping smaller than 1-1/2 inches and located in partitions within conditioned spaces, reduction of these thicknesses by 1 inch shall be permitted but not to a thickness less than 1 inch.

**3.12 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE**

- A. Hot Water and Geothermal Water Supply and Return:

1. NPS 1-1/4 and Smaller: Insulation shall be the following:

- a. Mineral Fiber: 1-1/2 inches thick, factory applied jacket.

2. NPS 1-1/2 and Larger: Insulation shall be the following:

- a. Mineral Fiber: 2 inches thick, factory applied jacket.

- B. Refrigerant Suction and Liquid:

1. All Pipe Sizes: Insulation shall be one of the following:

- a. Mineral Fiber: 1 inch thick, factory applied jacket.  
b. Closed Cell Elastomer: 1 inch thick.

**3.13 INDOOR, FIELD-APPLIED JACKET SCHEDULE**

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

- B. If more than one material is listed, selection from materials listed is Contractor's option.

- C. Piping, Concealed:

1. None.

- D. Piping, Exposed:

1. PVC: 30 mils thick.

**3.14 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE**

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

- B. If more than one material is listed, selection from materials listed is Contractor's option.

- C. Piping, Concealed:

1. Aluminum, Smooth, with Z-Shaped Locking Seam, aluminum bands, and moisture barrier lining: 0.016 inch thick.

- D. Piping, Exposed:



1. Aluminum, Smooth, with Z-Shaped Locking Seam, aluminum bands, and moisture barrier lining: 0.016 inch thick.

**END OF SECTION 230719**

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

- A. Section includes Cx process requirements for the following HVAC systems, assemblies, and equipment:
  - 1. Energy supply systems.
  - 2. Heat generation systems.
  - 3. Cooling generation systems.
  - 4. Central-station air-handling systems.
  - 5. Air and hydronic distribution systems.
  - 6. Heating and cooling terminal and unitary equipment.
  - 7. HVAC controls.
  - 8. TAB verification.
  - 9. Entire Geothermal System
- B. Related Requirements:
  - 1. Section 019113 "General Commissioning Requirements" for general Cx process requirements and CxA responsibilities.
  - 2. For construction checklists, comply with requirements in various Division 23 Sections specifying HVAC systems, system components, equipment, and products.

### 1.3 DEFINITIONS

- A. BAS: Building automation system.
- B. Cx: Commissioning, as defined in Section 019113 "General Commissioning Requirements."
- C. CxA: Commissioning Authority, as defined in Section 019113 "General Commissioning Requirements."
- D. IgCC: International Green Construction Code.
- E. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they mean "as-built" systems, assemblies, subsystems, equipment, and components.
- F. TAB: Testing, adjusting, and balancing.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For **BAS and HVAC** testing technician.
- B. Construction Checklists:
  - 1. Cx plan, including material, installation, and performance construction checklists for systems, assemblies, subsystems, equipment, and components relating to **BAS and HVAC** to be part of the Cx process and in accordance with requirements in Section 019113 "General Commissioning Requirements and ASHRAE 202."
- C. Test Equipment and Instruments: For all test equipment and instruments to be used in conducting Cx tests by Div. 23 Subcontractor, provide the following:
  - 1. Equipment/instrument identification number.
  - 2. Planned Cx application or use.
  - 3. Manufacturer, make, model, and serial number.
  - 4. Calibration history, including certificates from agencies that calibrate the equipment and instrumentation.
  - 5. Equipment manufacturers' proprietary instrumentation and tools. For each instrument or tool, identify the following:
    - a. Instrument or tool identification number.
    - b. Equipment schedule designation of equipment for which the instrument or tool is required.
    - c. Manufacturer, make, model, and serial number.
    - d. Calibration history, including certificates from agencies that calibrate the instrument or tool, where appropriate.

#### 1.5 QUALITY ASSURANCE

- A. BAS Testing Technician Qualifications: Technicians performing BAS Construction Checklist verification tests, Construction Checklist verification test demonstrations, Cx tests, and Cx test demonstrations are to have the following minimum qualifications:
  - 1. Journey level or equivalent skill level with knowledge of BAS, HVAC, electrical concepts, and building operations.
  - 2. Minimum [**three years'**] <Insert time> experience installing, servicing, and operating systems manufactured by approved manufacturer.
  - 3. International Society of Automation (ISA)-Certified Control Systems Technician (CCST) Level I.
- B. HVAC Testing Technician Qualifications: Technicians to perform HVAC Construction Checklist verification tests, Construction Checklist verification test demonstrations, Cx tests, and Cx test demonstrations shall have the following minimum qualifications:
  - 1. Journey level or equivalent skill level; vocational school four-year-program graduate or an Associate's degree in mechanical systems, air conditioning, or similar field. Degree may be offset by three years' experience in servicing mechanical systems in the HVAC industry. Generally, required knowledge includes HVAC systems, electrical concepts,

- building operations, and application and use of tools and instrumentation to measure performance of HVAC equipment, assemblies, and systems.
2. Minimum [**three years'**] **<Insert time>** experience that is to include installing, servicing, and operating systems manufactured by approved manufacturer.
- C. Testing Equipment and Instrumentation Quality and Calibration:
1. Capable of testing and measuring performance within the specified acceptance criteria.
  2. Be calibrated at manufacturer's recommended intervals with current calibration tags permanently affixed to the instrument being used.
  3. Be maintained in good repair and operating condition throughout duration of use on Project.
  4. Be recalibrated/repared if dropped or damaged in any way since last calibrated.
- D. Proprietary Test Instrumentation and Tools:
1. Equipment Manufacturer's Proprietary Instrumentation and Tools: For installed equipment included in the Cx process, test instrumentation and tools manufactured or prescribed by equipment manufacturer to service, calibrate, adjust, repair, or otherwise work on its equipment or required as a condition of equipment warranty, shall comply with the following:
    - a. Be calibrated by manufacturer with current calibration tags permanently affixed.
    - b. Include a separate list of proprietary test instrumentation and tools in operation and maintenance manuals.
  2. HVAC proprietary test instrumentation and tools become property of Owner at the time of Substantial Completion.

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 Cx PROCESS:

- A. Perform Cx process in accordance with Section 019113 "General Commissioning Requirements" for **BAS and HVAC** and in accordance with the following:
1. **ASHRAE 202.**
  2. **Commissioning standards acceptable to the authority having jurisdiction.**

### 3.2 CONSTRUCTION CHECKLISTS

- A. Prepare preliminary detailed construction checklists for each **BAS and HVAC** system, assembly, subsystem, equipment, and component required to be commissioned, as detailed in **ASHRAE 202.**

1. Submit preliminary construction checklists to CxA and Designer for review.
2. When review comments have been resolved, the CxA will provide final construction checklists marked "Approved for Use, (date)."
3. Use only construction checklists, marked "Approved for Use, (date)" when performing tests. Mark construction checklists in the appropriate place, as indicated Project events are completed and provide pertinent details and other information.

B. Systems required to be commissioned under:

1. Heating, ventilating, air-conditioning, and refrigeration systems (mechanical and/or passive) and associated controls.
2. Geothermal System & All associated equipment, including, but not limited to Pumps & Heat Exchangers.
3. Air-curtain systems.
4. Water-pumping and -mixing systems over 1 hp.
5. Renewable energy systems and energy storage systems.
6. Energy and building management and demand-control systems.
7. Solar-energy supply.
8. Demand-control systems.
  - a. <Insert supply sources>.
9. Heat generation systems, including the following:
  - a. Water-Source heat Pumps.
  - b. Auxiliary equipment.
10. Cooling generation systems, including the following:
  - a. Water-Source VRF System.
  - b. Direct-expansion refrigeration systems.
  - c. Auxiliary equipment.
11. Air-handling systems, including the following:
  - a. Supply, return, and exhaust air fans, motors, and drives.
  - b. Automatic and gravity dampers.
  - c. Heating and cooling devices.
  - d. Humidification and dehumidification devices.
  - e. Air filters.
  - f. Hangers and supports.
  - g. Interlock between air-handling system and fire/smoke alarm system.
12. Air duct systems, including the following:
  - a. Duct systems.
  - b. Air-duct accessories, including volume dampers, fire and smoke dampers, turning vanes, sound attenuators, and flexible connectors.
  - c. Duct-mounted access doors and panels.
  - d. Hangers and supports.
13. Air curtain systems.

- a. Supply air fans and motors.
  - b. Heating and cooling devices.
14. Hydronic distribution systems, including the following:
- a. Condensate piping systems, including condensate pumps and all accessories.
  - b. Hydronic piping systems and all accessories.
  - c. Pumps and all accessories.
  - d. Sleeves and sleeve seals.
  - e. Meters and gauges.
  - f. General-duty and specialty valves.
  - g. Hangers and supports
  - h. Heat tracing.
15. Refrigerant piping, including the following:
- a. Refrigerant piping, fittings, and specialties.
  - b. Refrigerant charge.
  - c. Sleeves and sleeve seals.
  - d. Meters and gauges.
  - e. General-duty and specialty valves.
  - f. Hangers and supports.
16. Smoke & Carbon Monoxide (Vehicle Exhaust Pollutants) -control systems, including the following:
- a. Exhaust and makeup fans, motors, and drives.
  - b. Exhaust and makeup air distribution systems.
  - c. Smoke dampers.
  - d. Smoke & CO / NOx Contaminant detectors.
  - e. Fire and smoke alarm system interface.
17. Heating and cooling terminal and unitary equipment, including the following:
- a. Unit ventilators.
  - b. Unit heaters.
  - c. Fan-coil units.
  - d. Electric heating.
  - e. Unitary heating and cooling equipment.
18. Vibration isolation systems.
19. Controls and instrumentation, including the following:
- a. Energy monitoring and recording system.
  - b. Controllers and sensors.
  - c. Automatic control valves, dampers, and actuators.
  - d. Control interface with fans, pumps, dampers, and other equipment and systems.
  - e. Demand-control systems.
20. TAB Verification:
- a. Airflow.

- b. Water flow.
- c. Space pressurization.

21. Documentation:

- a. Mechanical systems manuals.
- b. Documentation of required commissioning.

22. Mechanical insulation, including the following:

- a. Duct and plenum insulation.
- b. HVAC piping insulation.

3.3 Cx TESTING PREPARATION

- A. Certify that HVAC systems, subsystems, and equipment have been installed, calibrated, and started and that they are operating in accordance with the Contract Documents and approved submittals.
- B. Certify that HVAC instrumentation and control systems have been completed and calibrated, point-to-point checkout has been successfully completed, and systems are operating in accordance with their design sequence of operation, Contract Documents, and approved submittals. Certify that all sensors are operating within specified accuracy and all systems are set to and maintaining set points as required by the design documents.
- C. Certify that TAB procedures have been completed and that TAB reports have been submitted, discrepancies corrected, and corrective work approved.
- D. Set systems, subsystems, and equipment into operating mode to be tested in accordance with approved test procedures (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

3.4 Cx TEST CONDITIONS

- A. Perform tests using design conditions, whenever possible.
  - 1. Simulated conditions may, with approval of Architect, be imposed using an artificial load when it is impractical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by CxA, and document simulated conditions and methods of simulation. After tests, return configurations and settings to normal operating conditions.
  - 2. Cx test procedures may direct that set points be altered when simulating conditions is impractical.
  - 3. Cx test procedures may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are impractical.
- B. If tests cannot be completed because of a deficiency outside the scope of the HVAC system, document the deficiency and report it to Architect. After deficiencies are resolved, reschedule tests.

- C. If seasonal testing is specified, complete appropriate initial performance tests and documentation, and schedule seasonal tests.

### 3.5 Cx TESTS COMMON TO HVAC SYSTEMS

- A. Measure capacities and effectiveness of systems, assemblies, subsystems, equipment, and components, including operational and control functions, to verify compliance with acceptance criteria.
- B. Test systems, assemblies, subsystems, equipment, and components for operating modes, interlocks, control responses, responses to abnormal or emergency conditions, and response in accordance with acceptance criteria.
- C. Coordinate schedule with, and perform Cx activities at the direction of, CxA.
- D. Comply with Construction Checklist requirements, including material verification, installation checks, startup, and performance test requirements specified in Division 23 Sections specifying HVAC systems and equipment.
- E. Provide technicians, instrumentation, tools, and equipment to perform and document the following:
  - 1. Cx Construction Checklist verification tests.
  - 2. Cx Construction Checklist verification test demonstrations.

### 3.6 CONSTRUCTION CHECKLIST EXAMPLES

- A. Vibration Isolation in HVAC Systems:
  - 1. Prerequisites: Acceptance of results of construction checklists for vibration **and seismic** control devices specified in **Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment."**
  - 2. Components to Be Tested:
    - a. Vibration isolation control devices in HVAC systems.
    - b. Support systems.
  - 3. Test Purpose: Evaluate effectiveness of vibration isolation control devices.
  - 4. Test Conditions, Variable Speed Equipment: Measure vibration of the facility structure at **three (3)** locations designated by Owner's witness at the following operating conditions:
    - a. Maximum speed.
    - b. Minimum speed.
    - c. Critical speed.
  - 5. Acceptance Criteria: Structure-borne vibration not to exceed specified performance.
- B. Heat Tracing in HVAC Systems:



1. Prerequisites: Acceptance of results of construction checklists for heat tracing specified in HVAC systems. Comply with requirements listed in Section 230533 "Heat Tracing for HVAC Piping."
2. Equipment and Systems to Be Tested:
  - a. Self-regulating, parallel-resistance heating cables.
  - b. Heat tracing circuit controller.
3. Test Purpose:
  - a. Evaluate response to ambient temperature below freeze-protection set point.
  - b. Evaluate heating cable fault alarm.
4. Test Conditions:
  - a. Subject temperature sensor to temperature approximately **3 deg F** above freeze-protection set point (initial set point **41 deg F**. Monitor sensed temperature with a calibration-grade thermometer. Gradually change set point or sensed temperature until freeze-protection circuit is energized.
  - b. Subject temperature sensor to temperature approximately **3 deg F** below freeze-protection set point (initial set point **41 deg F** . Monitor sensed temperature with a calibration-grade thermometer. Gradually change set point or sensed temperature until freeze-protection circuit is de-energized.
  - c. Simulate an electrical fault on the heating cable.
5. Acceptance Criteria:
  - a. Freeze-protection circuit is energized at set-point temperature of minus **2 deg F**.
  - b. Freeze-protection circuit is de-energized at set-point temperature of plus **2 deg F**.
  - c. Heater trace circuit controller initiates an alarm of cable fault. Alarm is correctly reported at the alarm panel.

### 3.7 TAB VERIFICATION

- A. Prerequisites: Completion of "Examination" Article requirements and correction of deficiencies, as specified in Section 230593 "Testing, Adjusting, and Balancing for HVAC."
- B. Completion of "Preparation" Article requirements for preparation of a TAB plan that includes strategies and step-by-step procedures, and system-readiness checks and reports, as specified in Section 230593 "Testing, Adjusting, and Balancing for HVAC."
- C. Scope: HVAC air systems and hydronic piping systems.
- D. Purpose: Differential flow relationships intended to maintain air and water pressurization differentials between the various areas of Project.
- E. Conditions of the Test:
  1. Cx Test Demonstration Sampling Rate: As specified in "Inspections" Article in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

2. Systems operating in full heating mode **with minimum outside-air volume.**
3. Systems operating in full cooling mode **with minimum outside-air volume.**
4. For measurements at air-handling units with economizer controls; systems operating in economizer mode with 100 percent outside air.

F. Acceptance Criteria:

1. Under all conditions, rechecked measurements comply with "Inspections" Article in Section 230593 "Testing, Adjusting, and Balancing for HVAC."
2. Additionally, no rechecked measurement shall differ from measurements documented in the final report by more than the tolerances allowed.
3. Under all conditions, where the Contract Documents indicate a differential in airflow between supply and exhaust and/or return in a space, the differential relationship shall be maintained.

3.8 HEATING CONTROL SYSTEM Cx TESTS

A. Heating-Water Supply Temperature Control:

1. Prerequisites: Installation verification of the following:
  - a. Startup of Water-Source heat Pumps
  - b. Startup of heating-water pump(s)
  - c. TAB of heating-water flow and pressure.
  - d. Input Device: Heating-water supply temperature
  - e. Output Device: Control valve
  - f. Display the following at the operator's workstation:
    - 1) Heating-water supply temperature.
    - 2) Heating-water supply temperature set point.
    - 3) Control-valve position & Pumps Speeds.
2. Scope: Heating-water system.
3. Purpose: Control of heating-water supply temperature at input device
4. Conditions of the Test:
  - a. Minimum heating-water flow.
  - b. Midrange Heating-Water Flow: **50** percent of maximum.
  - c. Maximum heating-water flow.
5. Acceptance Criteria: Under all conditions, heating-water supply temperature is within plus or minus **2.0 deg F** of set point.

B. Heating-Water Supply Temperature Reset:

1. Prerequisites: Installation verification of the following:
  - a. Startup of Water-Source Heat Pump
  - b. Startup of heating-water pump(s).
  - c. TAB of heating-water flow and pressure.

- d. Input Device: Heating-water supply temperature;
- e. Input Device: Outdoor-air temperature; slab & air temperatures sensors.
- f. Output Device: Control valves & Pump VFD's
- g. Display the following at the operator's workstation:
  - 1) Outdoor-air temperature.
  - 2) Heating-water supply temperature.
  - 3) Heating-water supply temperature set point.
  - 4) Control-valve position and Pump Speeds.
- 2. Scope: Heating-water system.
- 3. Purpose: Control of heating-water supply temperature at heating-water supply temperature input device in response to variable outdoor-air temperature input and/or garage slab temperatures;
- 4. Acceptance Criteria: Heating-water supply temperature resets in straight-line relationship with outdoor-air temperature and/or garage slab temperatures. Under all conditions, heating-water supply temperature is within **2.0 deg F** of set point.
- 5. Prerequisites: Installation verification of the following:
  - a. Startup of heating-water pump(s).
  - b. Input Device: Outdoor-air temperature; **electric, outdoor-air-reset and garage slab temperature controller.**
  - c. Output Device: Heating-water pump; **DDC system command to starter**
  - d. Display the following at the operator's workstation:
    - 1) Outdoor-air and garage slab temperatures.
    - 2) Operating status of primary circulating pump(s).
- 6. Scope: Heating-water pump(s) and associated controls.
- 7. Purpose: On-off control of heating-water pump(s) in response to variable outdoor-air temperature input;

### 3.9 GEOTHERMAL SYSTEM Cx TESTS

#### A. Start-and-Stop Geothermal-Water Pump(s):

- 1. Prerequisites: Installation verification of the following:
  - a. Startup of geothermal-water pump(s)
  - b. Input Device: Water pressure transducer
  - c. Input Device: **DDC system**
  - d. Output Device: **DDC system binary output**
  - e. Display the following at the operator's workstation:
    - 1) Outdoor-air temperature.
    - 2) Cooling or heating (software) demand indication.
    - 3) Time and time schedule.
    - 4) Geothermal-water pump(s) on-off status.
    - 5) Geothermal-water pump(s) on-off indication.

- 6) Geothermal-water flow indication.
2. Scope:
    - a. Geothermal-water system, including pump(s), and associated controls.
  3. Purpose:
    - a. Pump(s) lockout.
    - b. Pump(s) start.
    - c. Pump(s) shutdown.
    - d. Pump(s) time-of-day schedule.
  4. Conditions of the Test:
    - a. Verify Lockout: Start with geothermal-water pump enable-input devices in the "disable" state to prevent pump start. One by one, place the enable-input devices in the "enable" state, and then return each to the "disable" state before placing the next enable-input device to the "enable" state.
    - b. Verify Start: Start with geothermal-water pump enable-input devices in the "disable" state to prevent pump start. One by one, place the enable-input devices in the "enable" state.
    - c. Verify Shutdown: Place all enable-input devices in the "enable" state to allow the pump(s) to start. One by one, place the enable-input devices in the "disable" state, and then return each to the "enable" state before placing the next enable-input device to the "disable" state.
    - d. Verify Schedule: Compare geothermal-water pump start-and-stop schedule times with Owner-approved time-of-day schedule.
  5. Acceptance Criteria:
    - a. Lockout: No single enable-input device starts the pump(s) when released to the "enable" state.
    - b. Start: Pump(s) start when, and only when, all enable-input devices are in the "enable" state.
    - c. Shutdown: Each enable-input device stops the pump(s) when placed in the "disable" state, regardless of the state of other enable-input devices.
    - d. Schedule: Pump start-and-stop schedule times agree with Owner-approved time-of-day schedule.

### 3.10 AIR-HANDLING SYSTEM Cx TESTS

Retain applicable paragraphs below for Project's air-handling unit(s). If a project has more than one type of air-handling unit, copy this article and re-edit for each product.

- A. Supply Fan(s) Variable-Volume Control:
  1. Prerequisites: Installation verification of the following:

- a. Volume-Control Input Device: [Static-pressure transmitter] [Differential-pressure switch] sensing supply-duct static pressure referenced to conditioned-space static pressure.
- b. Volume-Control Output Device: [Receiver controller] [DDC system analog output] [DDC system analog output to digital-to-pneumatic transducer] to modulating damper actuator. Set inlet guide vanes to [minimum] [closed] position when fan is stopped.

Retain last two subparagraphs above for fans equipped with variable inlet vanes; retain first two subparagraphs below for fans equipped with variable-speed drives.

- c. Volume-Control Input Device: [Static-pressure transmitter] [Differential-pressure switch] sensing supply-duct static pressure referenced to conditioned-space static pressure.
  - d. Volume-Control Output Device: [Receiver controller] [DDC system analog output] to motor speed controller. Set variable-speed drive to minimum speed when fan is stopped.
  - e. High-Pressure Input Device: Static-pressure transmitter sensing supply-duct static pressure referenced to static pressure outside the duct.
  - f. High-Pressure Output Device: [Receiver controller] [DDC system binary output] to [alarm panel] [motor starter].
  - g. Display the following at the operator's workstation:
    - 1) Supply-fan-discharge static-pressure indication.
    - 2) Supply-fan-discharge static-pressure set point.
    - 3) Supply-fan airflow rate.
    - 4) Supply-fan [inlet vane position] [speed].
2. Scope: VAV supply fan units and associated controls.
  3. Purpose:
    - a. Supply-air discharge static pressure control.
    - b. Response to excess supply-air discharge static pressure condition.
  4. Conditions of the Test:
    - a. Minimum supply-air flow.
    - b. Midrange Supply-Air Flow: [50 to 60] <Insert number(s)> percent of maximum.
    - c. Maximum supply-air flow.
    - d. Excess supply-air discharge static pressure.
  5. Acceptance Criteria:
    - a. At all supply-air flow rates, and during changes in supply-air flow, discharge air static pressure is at set point plus or minus [2] <Insert number> percent.
    - b. Fan stops and an alarm is initiated at the operator's workstation when supply-air discharge static pressure is at the excess static pressure, plus or minus [2] <Insert number> percent.

B. Water-Source VRF Equipment and associated Air-Handlers / Fan Coils:

1. Prerequisites: Installation verification of the following:

- a. Minimum Position Input Device: **DDC system time schedule.**
  - b. Output Device: **DDC system analog output to digital-to-pneumatic transducer** to modulating damper actuator(s).
  - c. Air Temperature Input Devices
  - d. Display the following at the operator's workstation:
    - 1) Mixed-air-temperature indication.
    - 2) Mixed-air-temperature set point.
    - 3) Mixed-air damper position.
2. Scope: Air handler with mixed-air control and associated controls.
3. Purpose:
  - a. Occupied time control.
  - b. Minimum damper position control.
  - c. **Supply**-air temperature control.
  - d. Unoccupied time control.
4. Conditions of the Test:
  - a. Occupied Time Control: Start in unoccupied schedule. Advance to occupied schedule time.
  - b. Minimum Damper Position Control: Command system to mode in which minimum damper position is required.
  - c. Unoccupied Time Control: Advance to unoccupied schedule time.
  - d. Control Data Trend Log: Set up a data trend log of the following input device values and output device commands. Record data at **hourly** intervals. Submit trend data for **24-hour** periods in which natural conditions require heating and cooling control.
5. Acceptance Criteria:
  - a. Occupied Time Control: Mixed-air control is active in occupied mode.
  - b. Minimum Damper Position Control: Controller **opens minimum outdoor-air dampers and positions outdoor-air dampers to minimum position**].
  - c. Air Temperature Control:
  - d. Unoccupied Time Control: Controller positions outdoor- and relief-air dampers closed and return-air dampers open.
  - e. Control Data Trend Log: Data verify control in accordance with sequence of control.

END OF SECTION 230800

**PART 1**        **GENERAL**

**1.1**            **REFERENCES**

~~.1~~        ~~ANSI/CSA/IGSHPA C448 Series 16 (R2021), Design and Installation of Ground Source Heat Pump Systems for Commercial and Residential Buildings~~

~~.1.2~~      American Standard for Testing and Materials (ASTM).

- .1        ASTM D1693, Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics.
- .2        ASTM D2447, Standard Specification for Polyethylene (PE) Plastic Pipe, Schedule 40 and 80, Based on Outside Diameter.
- .3        ASTM D2513, Standard Specification for Thermoplastic Gas Pressure Pipe, Tubing and Fittings.
- .4        ASTM D2683, Standard Specification for Socket-Type Polyethylene Fittings For Outside Diameter-Controlled Polyethylene Pipe and Tubing.
- .5        ASTM D2837, Standard Test Method for Obtaining Hydrostatic Design for Thermoplastic Pipe Materials or Pressure Design Bases for Thermoplastic Pipe Properties.
- .6        ASTM D3035, Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
- .7        ASTM D3261, Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene Plastic Pipe and Tubing.
- .8        ASTM D3350, Standard Specification for Polyethylene Plastic Pipe and Fittings Materials.

~~.2~~        ~~Canadian Standards Association (CSA)~~

~~.1~~        ~~CSA C448, Design and Installation of Earth Energy Systems.~~

.3        International Ground Source Heat Pump Association (IGSHPA) Installation Manuals.

**1.2**            **PRODUCT DATA**

.1        Submittals Package: Submit produce data in accordance with Section 01 33 00 - Submittal Procedures.

.2        Product Data: Manufacturer's catalog sheets, specifications and installation instructions for each item specified.

.3        Quality Control Submittals:

.1        Geothermal System Installer's Qualifications Data:

- .1        Name of each person who will be performing the geothermal work and their employer's name, business address and telephone.
- .2        Names and addresses of 3 similar projects that each person has worked on.
- .3        Copy of installer's personal experience demonstrating the use of        thermal fusion techniques for polyethylene piping.

.2        Geothermal System Supervisor's Qualifications Data:

- .1 Name of person overseeing the geothermal work and their name, business address and telephone number.
- .2 Names and addresses of 3 similar projects that the supervisor has overseen during the past 5 years.
- .3 Copy of installer's personal experience demonstrating the use of thermal fusion techniques for polyethylene piping.
- .3 Geothermal System Contractor's Qualifications Data:
  - .1 Names and addresses of 3 geothermal projects that the contractor has completed during the past 5 years.

~~.4~~

.4 Product Manuals

- .1 IGSHPA Installation Manuals: Maintain one copy on site for review.
- .4.2 ANSI/CSA/IGSHPA C448 Series 16 (R2021): Maintain one copy on site for review.

### 1.3 CONTRACTOR'S QUALIFICATIONS

- .1 Geothermal System Installer Qualifications: The persons performing geothermal work shall be personally trained in polyethylene pipe fusion techniques by IGSHPA or piping manufacturer, personally experienced in geothermal work and shall have been regularly employed by a Company performing geothermal work for a minimum of 2 years.
- .2 Geothermal System Supervisor's Qualifications: The supervisor overseeing the geothermal work shall be personally trained in polyethylene pipe fusing techniques by IGSHPA or piping manufacturing, personally experienced in geothermal work, and shall have been regularly employed by a Company performing geothermal work for a minimum of 2 years.
- .3 Geothermal System Contractor Qualifications: The contractor shall have completed geothermal work on at least 3 projects with vertical boreholes within the last 5 years.
- ~~.3.4~~ Geothermal Contractor shall be accredited and certified by IGSHPA.

### 1.4 REGULATORY REQUIREMENTS

- .1 Perform field testing of piping systems in complete accordance with the local Utilities and other agencies having jurisdiction and as specified.
- ~~.1.2~~ All work shall be completed in accordance with the requirements of the Authority Having Jurisdiction (AHJ). Pay for permitting and all other costs associated with complying with AHJ requirements.

### 1.5 PRODUCT CONDITION

- .1 Protection: During all test work, protect adjacent buildings, equipment, vehicles, etc., against damage from all testing activities.
- ~~.1.2~~ Repair any damages or any surfaces marred by the work.



## 1.6 SEQUENCING AND SCHEDULING

- .1 Transmit written notification of proposed date and time of tests to the ~~Owner's Departmental~~ Representative at least 2 days in advance of such tests.
- .2 Perform cleaning and testing work in the presence of the ~~Departmental~~Owner's Representative.

## 1.7 WARRANTY

- .1 Manufacturer's Warranty:
  - .1 Minimum 50 years warranty for polyethylene piping.
- .2 Special Warranty:
  - .1 25 years for butt fusion welds in polyethylene piping against leakage.

## 1.8 WATER, SILT AND SOIL CONTAINMENT AND REMOVAL

- .1 The Contractor shall submit a detailed proposal outlining his proposed methodology for containing and removing and runoffs created by the well drilling and piping installation.
- .2 Dewater each borehole during drilling utilizing an interceptor and water sump tank arrangement. Remove water from site in a manner accountable to all authorities having jurisdiction.

## PART 2 PRODUCTS

### 2.1 HIGH DENSITY POLYETHYLENE (P.E.) PIPE AND FITTINGS

- .1 Pipe and fittings shall be manufactured based on polymers made with ethylene as the sole monomer, which meet the requirements of PE Type III for water distribution.
- .2 PE Type III pipe shall have a 23.2 kPa (160 PSI) design stress at 23°C (73.4°F) which is listed by the Plastics Pipe Institute (PPI).
- .3 The piping shall be PE3408 (high density polyethylene) with minimum cell classification ~~345434C~~ 345464C per ASTM D 3350. Resistance to environmental stress cracking is critical to long life expectancy. Therefore, as a more stringent requirement, the piping shall experience zero failures (Fo) after 5,000 hours under condition "C" (100% reagent @ 100°C) when tested in accordance with ASTM D1693. A 50 year limited warranty (in writing) must be issued by the pipe manufacturer. U-type fittings shall be shop fabricated under quality controlled conditions of the same material designation and shall be ASTM D-3261 certified.
- .4 Pipe shall conform to ASTM D3035 and ASTM D3261 for butt fusion fittings. U-bend joints shall be butt head fused or socket welded.
- .5 Pipe must be designed and fabricated by manufacturer specifically for geothermal heat pump applications.
- .6 All joints shall be fusion weld. Welds are to be numbered and recorded electronically by welding machine. A copy of the weld report and drawing of the well field indicating

weld location is to be submitted to the ~~Departmental Owner's~~ Representative prior to backfilling the field.

- .7 The complete assembly of piping within the borehole must be continuous without any joints except at the bottom U-BEND located where only a thermally fused joint or socket welded joint will be acceptable.

.8 All piping shall be sealed at the factory and contain a compressed air charge. The presence of the air charge must be witnessed at the site prior to hydrostatic testing. Piping without an air charge will not be accepted.

.8.9 All piping shall be SDR 11 wall thickness.

## 2.2 ANTI-FREEZE

- .1 Provide a 25% by volume solution of industrial inhibited propylene glycol charge and water for all the entire ground source heat pump closed loop piping.

- .2 The performance characteristics shall be as follows:

.1 Viscosity shall be no more than 5.00 centipoise at ~~-1.130°F~~ with blend for ~~-9.415°F~~ freeze protection;

.2 Specific heat shall be 1.05 at ~~2170°F~~ with blend for ~~15°F -9.4°C~~ freeze protection.

.3 Specific gravity shall be 0.982 at ~~1050°F~~ with blend for ~~-15°F -9.4°C~~ freeze.

.4 Pressure drop and Reynolds Number for a ~~11.3 l/m3~~ gpm flow in NPS ¾ IPS SDR-11 PE pipe of a ~~-1.1°C30°F~~ mixture for a ~~15°F -9.4°C~~ freeze protected blend shall be no more than ~~0.862.8 ft-m~~ of HD per ~~30.0100 ft m~~ of pipe and no less than Re=2028 respectively.

- .3 The fluid shall mix easily and readily with water and shall not damage or corrode common tools.

- .4 The fluid shall have a good or excellent material compatibility with iron, copper, red and yellow brass, ~~p~~Polyethylene, PVC, Viton, Buna "N" neoprene and nylon and shall include an oxygen scavenger blend to reduce any corrosion capability. The fluid shall not have a low surface tension to prevent leakage.

- .5 The fluid shall have a NFPA Health rating of 0 (least risk).

- .6 The Contractor shall provide a certified test report from a recognized lab stating glycol concentration.

.7 The product shall be available in plastic ~~19 liter (5 gallon )~~ pails, plastic ~~208 liter (55 gallon )~~ drums, or bulk tanker.

.7.8 See also ANSI/CSA/IGSHPA C448 Series 16 (R2021) for additional heat transfer fluid requirements. In case of a discrepancy, the most stringent requirement shall apply.

## 2.3 BOREHOLE GROUT

- .1 Provide grout for each of the boreholes as indicated on the drawings.

- .2 Grout to be a single component thermally enhanced bentonite grout consisting of 25% solids and polymer free mixed with water as follows: ~~68L-18 gal~~ water per ~~22.7 kg~~ 50 lb bentonite grout.
- .3 Grout shall have a minimum thermal conductivity of 1.2 btu/hr\*ft\*F.
- .4 Grout shall comply with ANSI/NSF 60.
- .5 See also ANSI/CSA/IGSHPA C448 Series 16 (R2021) for additional grout requirements. In case of a discrepancy, the most stringent requirement shall apply.

.2

### **PART 3**      **EXECUTION**

#### **3.1**      **GENERAL**

- .1 All geothermal work (including but not limited to materials, installation, testing, flushing) shall be completed in accordance with ANSI/CSA/IGSHPA C448 Series 16 (R2021), IGSHPA Manuals & Design and Installation Standards, and the requirements of the AHJ. In case of discrepancies or conflicting information, the most stringent requirement(s) shall apply.

#### **3.13.2**      **GEOHERMAL BOREHOLE PIPING INSTALLATION**

- .1 The ~~C~~e contractor shall obtain all necessary permits associated with the described work.
- .2 The borehole drilling contractor shall be experienced in deep bore hole drilling and shall have a minimum of 10 years drilling experience within the geographic vicinity of the project or shall subcontract to an approved drilling contractor with equivalent experience.
- .3 The vertical holes shall be drilled no closer than ~~68-10-m~~ 25 feet apart and shall be held open by a “mud” casing so that the piping can be inserted. The piping shall be tested in accordance with other sections of this specification prior to insertion. Loops must be installed from or by a mechanical device so that the pipe is not rolled out on the ground before installation.
- .4 Install polyethylene piping in accordance with details on drawings.
- .5 The piping shall be capped and protected for future connection.
- .6 Approved borehole seals should be tightened to manufacturer’s specifications.
- .7 The entire piping system shall be pressure tested in accordance with other sections of this specification before any backfilling of trench is permitted.
- .8 The ~~Departmental Owner’s~~ Representative shall be notified 24 hours prior to the test and shall, at this discretion, witness the test.
- .9 The ~~e~~C contractor shall maintain an accurate record of all borehole locations and at the completion of the work, deliver to the ~~Departmental Owner’s~~ Representative a set of “as-builts” site plans.

### **3.23.3 GROUTING BOREHOLE**

- .1 Bore-holes in vertical heat exchangers shall be tremi-grouted. Grouting of vertical heat exchangers shall be done in accordance with jurisdictional requirements of IGSHA standards. Grouting shall immediately follow the completion of drilling and installation of each borehole piping. A large capacity grout mixer/separate holding tank are required and a minimum of ~~25-mm~~ 1" diameter polyethylene tubing shall be used as the tremi-grout pipe. The tremi-grout pipe shall be attached to the u-bend heat exchanger before it is lowered into the ground.
- .2 Grouting procedures to be as follows:
  - .1 Monitor the grouting operation to ensure grout is being adequately mixed in correct proportions and that the viscosity is adequate for pumping down the borehole.
  - .2 The grout contractor should have spare grout pipes, hoses, fittings, readily available on site.
  - .3 A screw-type pump or a piston pump shall be used to pump grouts down the boreholes.
  - .4 A ~~75 to 100 mm~~ 3" to 4" inside diameter suction line and a ~~25 to 50 mm~~ 1" to 2" discharge line shall be used.
  - .5 Bentonite based grout shall be used mixed with water in proportions recommended by manufacturer. ~~For Volelay Grout II (25% solids) utilize a mixture of 68L per 22.7 kg of grout.~~ Cement based grout will not be used.

### **3.4 FLUSHING**

- .1 Each supply and return circuit shall be flushed and purged in the forward and reverse directions with water at a minimum velocity 2 ft/sec through each piping section. Maintain flow in each direction for at least 15 minutes in each direction. Contractor to provide their own pumps to complete this work.
- .2 Flow rates and pressure drops will be compared to calculated values to ensure there are no blockages or kinking of piping. If actual flow rate or pressure drop differs from calculated values by more than 10%, the problem shall be identified and corrected.

### **3.33.5 PIPING SYSTEMS TEST**

- .1 The Contractor shall provide all necessary equipment and shall perform all work required in connection with all piping system tests.
- .2 At the water working pressure of the pipe installed, all water piping systems shall be tested. Each section tested shall be slowly filled with water. Care shall be taken to expel all air from pipes. If necessary, the pressure, as measured at the point of lowest elevation, shall be applied for not less than ½ hour. When the test pressure has fallen over 5%, the point of leakage shall be found, repaired and tested repeated. This procedure shall be followed until the piping systems have been proved absolutely tight. The use of any chemicals, any "Stop-Leak" compounds, any mastic or any other temporary means shall not be used for repairing leaks during or subsequent to these tests.
- .3 Polyethylene pipe testing:
  - .1 Prior to insertion of the vertical pipe, the contractor shall assembly the "U Bend" and piping, cap both ends, and air pressure test the piping to a pressure of ~~862 kPa~~ (125

PSI). The test must be maintained for 8 hours minimum without the pressure falling more than ~~20 kPa (3 PSI)~~.

.2 Loops shall pass the test at the following milestones:

- .1 Before insertion into hole.
- .2 After insertion into hole.
- .3 Contractor is responsible to provide evidence of and certification of pressure testing, and acceptance of all work performed by signature of ~~Departmental~~ Owner's Representative.

**END OF SECTION**

## **PART 1 - GENERAL**

### **1.1 RELATED DOCUMENTS**

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

### **1.2 SUMMARY**

- A. Section includes pipe and fitting materials and joining methods for the following:

1. Hot-water heating piping.
2. Glycol chilled water piping.
3. Makeup-water piping.
4. Condensate-drain piping.
5. Safety-valve-inlet and -outlet piping.

### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of the following:

1. Steel pipe and fittings
2. Copper pipe and fittings

- B. Design Performance-Based Submittal:

1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
2. Locations of pipe anchors and alignment guides and expansion joints and loops.
3. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.
4. Locations of and details for penetration and firestopping for fire- and smoke-rated wall and floor and ceiling assemblies.

### **1.4 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Piping layout, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.
2. Other building services.
3. Structural members.

- B. Qualification Data: For Installer.

- C. Welding certificates.

- D. Field quality-control reports.

### **1.5 QUALITY ASSURANCE**

- A. Installer Qualifications:

- B. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

- C. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
1. Hot-Water Heating Piping: 150 psig at 220 deg F.
  2. Glycol chilled water piping: 150 psig at 220 deg F.
  3. Makeup-Water Piping: 80 psig at 150 deg F.
  4. Condensate-Drain Piping: 150 deg F.
  5. Air-Vent Piping: 200 deg F.
  6. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

### **2.2 COPPER TUBE AND FITTINGS**

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L or K.
- B. Wrought copper fittings.

### **2.3 STEEL PIPE AND FITTINGS**

- A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.
- B. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in "Piping Applications" Article.
- C. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in "Piping Applications" Article.
- D. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- E. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
1. Material Group: 1.1.
  2. End Connections: Butt welding.
  3. Facings: Raised face.
- F. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

### **2.4 JOINING MATERIALS**

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise 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.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.
- E. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- F. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

## **2.5 DIELECTRIC FITTINGS**

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. A.Y. McDonald Mfg. Co.
    - b. Capitol Manufacturing Company.
    - c. Central Plastics Company.
    - d. Hart Industries International, Inc.
    - e. Jomar International, Ltd.
    - f. Matco-Norca.
    - g. Watts Regulator Co.
    - h. Zurn Industries, LLC; AquaSpec Commercial Faucet Products.
  - 2. Description:
    - a. Standard: ASSE 1079.
    - b. Pressure Rating: Match pressure and temperature rating of piping system where used.
    - c. End Connections: Solder-joint copper alloy, welded ferrous.
- C. Dielectric Nipples:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Elster Perfection.
    - b. Grinnell Mechanical Products.
    - c. Matco-Norca.
    - d. Precision Plumbing Products, Inc.
    - e. Victaulic Company.
  - 2. Description:
    - a. Standard: IAPMO PS 66.
    - b. Electroplated steel nipple, complying with ASTM F 1545.
    - c. Pressure Rating: Match pressure and temperature rating of piping system where used.
    - d. End Connections: Solder-joint copper alloy, welded ferrous.
    - e. Lining: Inert and noncorrosive, propylene.

## **PART 3 - EXECUTION**

### **3.1 PIPING APPLICATIONS**

- A. General:
  - 1. Threaded, grooved, or compression joints shall not be allowed on this project, unless specifically noted below as an exception.



- B. Hot water piping and Glycol Chilled Water up to 220°F and 150 psig, above ground:
  - 1. NPS 2 and Smaller, shall be any of the following:
    - a. Hard Copper, Type L, ASTM A88, wrought-copper fittings, and silver soldered or brazed joints.
    - b. Black Steel, Schedule 40, ASTM A53 or A106, Seamless, Grade B, with socket welded joints and 2000 lb class forged steel fittings.
  - 2. NPS 2-1/2 to NPS 10:
    - a. Black Steel, Schedule 40, ASTM A53 or A106, Seamless, Grade B, with welded joints and wrought steel fittings same weight as pipe.
- C. Cold water makeup and fill piping, above ground:
  - 1. NPS 2 and Smaller:
    - a. Hard Copper, Type L, ASTM A88, wrought-copper fittings, and silver soldered or brazed joints.
- D. Cold condensate drain and miscellaneous drain piping, above ground:
  - 1. NPS 2 and Smaller:
    - a. Hard Copper, Type L, ASTM A88, wrought-copper fittings, and silver soldered or brazed joints.
- E. Air vent piping, above ground:
  - 1. NPS 2 and Smaller:
    - a. Hard Copper, Type K, ASTM A88, wrought-copper fittings, and silver soldered or brazed joints.
- F. Piping to miscellaneous gauges:
  - 1. NPS 2 and Smaller:
    - a. Red brass, standard wall, ASTM B34 seamless, with threaded joints.
- G. Safety-Valve Inlet and Outlet Piping:
  - 1. Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.

### **3.2 PIPING INSTALLATIONS**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install all piping at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.

- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- M. Provide Inspect air vents at high points of system
- N. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- O. All horizontal condensate piping shall be pitched a minimum of 1/8 inch per foot of length, and shall be a minimum of NPS 3/4.
- P. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- Q. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- R. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."
- S. Install unions in piping adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- T. Install flanges in piping and larger at final connections of equipment and elsewhere as indicated, see details.
- U. Install shutoff valve immediately upstream of each dielectric fitting.
- V. Comply with requirements in Division 23 Section "Expansion Fittings and Loops for HVAC Piping" for installation of expansion loops, expansion joints, anchors, and pipe alignment guides.
- W. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for identifying piping.
- X. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."
- Y. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."
- Z. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 23 Section "Escutcheons for HVAC Piping."

### **3.3 DIELECTRIC FITTING INSTALLATION**

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing, such as steel and copper.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric nipples.

### **3.4 HANGERS AND SUPPORTS**

- A. Comply with requirements in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.

- B. Install the following pipe attachments:
1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
  2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
  3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
  4. Spring hangers to support vertical runs.
  5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
  6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

- C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 7 feet.
2. NPS 1: Maximum span, 7 feet.
3. NPS 1-1/2: Maximum span, 9 feet.
4. NPS 2: Maximum span, 10 feet.
5. NPS 2-1/2: Maximum span, 11 feet.
6. NPS 3 and Larger: Maximum span, 12 feet.

- D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/4: Maximum span, 6 feet; minimum rod size, 3/8 inch.
4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
6. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
7. NPS 3 and Larger: Maximum span, 10 feet; minimum rod size, 3/8 inch.

- E. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

### **3.5 PIPE JOINT CONSTRUCTION**

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.
- E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- F. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
- G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

### **3.6 TERMINAL EQUIPMENT CONNECTIONS**

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
- D. Install ports for pressure gages and thermometers at coil inlet and outlet connections. Comply with requirements in Division 23 Section "Meters and Gages for HVAC Piping."

### **3.7 FIELD QUALITY CONTROL**

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
  - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
  - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
  - 3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
  - 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
  - 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on hydronic piping:
  - 1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
  - 2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
  - 3. Isolate expansion tanks and determine that hydronic system is full of water.
  - 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure, but not less than 100 PSI. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
  - 5. After hydrostatic test pressure has been applied for at least 2-hours, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
  - 6. Prepare written report of testing.
- C. Perform the following before operating the system:
  - 1. Open manual valves fully.
  - 2. Inspect pumps for proper rotation.
  - 3. Set makeup pressure-reducing valves for required system pressure.
  - 4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
  - 5. Set temperature controls so all coils are calling for full flow.
  - 6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
  - 7. Verify lubrication of motors and bearings.

**END OF SECTION 232113**

## **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 special-duty valves and specialties for the following:

1. Hot-water heating piping.
2. Glycol chilled water piping.
3. Makeup-water piping.
4. Condensate-drain piping.
5. Air-vent piping.
6. Safety-valve-inlet and -outlet piping.

### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of the following:
  1. Valves: Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
  2. Air-control devices.
  3. Hydronic specialties.

### **1.4 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For air-control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

### **1.5 MAINTENANCE MATERIAL SUBMITTALS**

- A. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

### **1.6 QUALITY ASSURANCE**

- A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
  1. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Hydronic piping components and installation shall be capable of withstanding the minimum working pressure and temperature ratings indicated in Division 23 Section "Hydronic Piping".

### **2.2 VALVES**

- A. Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping."

- B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "Instrumentation and Control for HVAC." "
- C. Bronze, Calibrated-Orifice, Balancing Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Armstrong Pumps, Inc.
    - b. Bell & Gossett Domestic Pump.
    - c. Flow Design Inc.
    - d. Gerand Engineering Co.
    - e. Griswold Controls.
    - f. Nexus Valve, Inc.
    - g. Taco.
    - h. Tour & Andersson; available through Victaulic Company.
  2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
  3. Ball: Brass or stainless steel.
  4. Plug: Resin.
  5. Seat: PTFE.
  6. End Connections: Threaded or socket.
  7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
  8. Handle Style: Lever, with memory stop to retain set position.
  9. Minimum Working Pressure and Temperature: 150 psig at 220 deg F, unless otherwise indicated in Division 23 "Hydronic Piping".
- D. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Armstrong Pumps, Inc.
    - b. Bell & Gossett Domestic Pump.
    - c. Flow Design Inc.
    - d. Gerand Engineering Co.
    - e. Griswold Controls.
    - f. Nexus Valve, Inc.
    - g. Taco.
    - h. Tour & Andersson.
  2. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
  3. Ball: Brass or stainless steel.
  4. Stem Seals: EPDM O-rings.
  5. Disc: Glass and carbon-filled PTFE.
  6. Seat: PTFE.
  7. End Connections: Flanged or grooved.
  8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
  9. Handle Style: Lever, with memory stop to retain set position.
  10. Minimum Working Pressure and Temperature: 150 psig at 220 deg F, unless otherwise indicated in Division 23 "Hydronic Piping".
- E. Diaphragm-Operated, Pressure-Reducing Valves: ASME labeled.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. AMTROL, Inc.
    - b. Armstrong Pumps, Inc.
    - c. Bell & Gossett Domestic Pump.
    - d. Conbraco Industries, Inc.
    - e. Spence Engineering Company, Inc.
    - f. Watts Regulator Co.
  2. Body: Bronze or brass.
  3. Disc: Glass and carbon-filled PTFE.

4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Low inlet-pressure check valve.
8. Inlet Strainer: stainless steel, removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.
11. Minimum Working Pressure and Temperature: 150 psig at 220 deg F, unless otherwise indicated in Division 23 "Hydronic Piping".

F. Diaphragm-Operated Safety Valves: ASME labeled.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AMTROL, Inc.
  - b. Armstrong Pumps, Inc.
  - c. Bell & Gossett Domestic Pump.
  - d. Conbraco Industries, Inc.
  - e. Spence Engineering Company, Inc.
  - f. Watts Regulator Co.
2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Wetted, Internal Work Parts: Brass and rubber.
8. Inlet Strainer: Stainless steel, removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.
11. Minimum Working Pressure and Temperature: 150 psig at 220 deg F, unless otherwise indicated in Division 23 "Hydronic Piping".

G. Automatic Flow-Control Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Flow Design Inc.
  - b. Griswold Controls.
  - c. Nexus Valve, Inc.
2. Body: Brass or ferrous metal.
3. Piston and Spring Assembly: Stainless steel, tamper proof, self-cleaning, and removable.
4. Combination Assemblies: Include bronze or brass-alloy ball valve.
5. Identification Tag: Marked with zone identification, valve number, and flow rate.
6. Size: Same as pipe in which installed.
7. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
8. Minimum Working Pressure and Temperature: 150 psig at 220 deg F, unless otherwise indicated in Division 23 "Hydronic Piping".

## 2.3 AIR-CONTROL DEVICES

A. Manual Air Vents:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AMTROL, Inc.
  - b. Armstrong Pumps, Inc.
  - c. Bell & Gossett Domestic Pump.
  - d. Nexus Valve, Inc.
  - e. Taco, Inc.

2. Body: Bronze.
3. Internal Parts: Nonferrous.
4. Operator: Screwdriver or thumbscrew.
5. Inlet Connection: NPS 1/2.
6. Discharge Connection: NPS 1/8.
7. Minimum Working Pressure and Temperature: 150 psig at 220 deg F, unless otherwise indicated in Division 23 "Hydronic Piping".

B. Automatic Air Vents:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AMTROL, Inc.
  - b. Armstrong Pumps, Inc.
  - c. Bell & Gossett Domestic Pump.
  - d. Nexus Valve, Inc.
  - e. Taco, Inc.
2. Body: Bronze or cast iron.
3. Internal Parts: Nonferrous.
4. Operator: Noncorrosive metal float.
5. Inlet Connection: NPS 1/2.
6. Discharge Connection: NPS 1/4.
7. Minimum Working Pressure and Temperature: 150 psig at 220 deg F, unless otherwise indicated in Division 23 "Hydronic Piping".

C. Diaphragm-Type Expansion Tanks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AMTROL, Inc.
  - b. Armstrong Pumps, Inc.
  - c. Bell & Gossett Domestic Pump.
  - d. Taco, Inc.
2. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature. Factory test after taps are fabricated and supports installed and are labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
3. Diaphragm: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
4. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.
5. Minimum Working Pressure and Temperature: 150 psig at 220 deg F, unless otherwise indicated in Division 23 "Hydronic Piping".

D. Tangential-Type Air Separators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AMTROL, Inc.
  - b. Armstrong Pumps, Inc.
  - c. Bell & Gossett Domestic Pump.
  - d. Taco, Inc.
2. Tank: Welded steel; ASME constructed and labeled for 125-psig minimum working pressure and 375 deg F maximum operating temperature.
3. Air Collector Tube: Perforated stainless steel, constructed to direct released air into expansion tank.
4. Tangential Inlet and Outlet Connections: Threaded for NPS 2 and smaller; flanged connections for NPS 2-1/2 and larger.
5. Blowdown Connection: Threaded.
6. Size: Match system flow capacity.
7. Minimum Working Pressure and Temperature: 150 psig at 220 deg F, unless otherwise indicated in Division 23 "Hydronic Piping".



E. In-Line Air Separators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AMTROL, Inc.
  - b. Armstrong Products, Inc.
  - c. Bell & Gossett Domestic Pump.
  - d. Taco, Inc.
2. Tank: One-piece cast iron with an integral weir constructed to decelerate system flow to maximize air separation.
3. Minimum Working Pressure and Temperature: 150 psig at 220 deg F, unless otherwise indicated in Division 23 "Hydronic Piping".

F. Air Purgers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AMTROL, Inc.
  - b. Armstrong Pumps, Inc.
  - c. Bell & Gossett Domestic Pump.
  - d. Taco, Inc.
2. Body: Cast iron with internal baffles that slow the water velocity to separate the air from solution and divert it to the vent for quick removal.
3. Minimum Working Pressure and Temperature: 150 psig at 220 deg F, unless otherwise indicated in Division 23 "Hydronic Piping".

**2.4 HYDRONIC PIPING SPECIALTIES**

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Flanged.
3. Strainer Screen:
  - a. NPS 2 and smaller: Stainless-steel 20-mesh screen.
  - b. NPS 2-1/2 to NPS 8: Stainless-steel basket with 1/8 inch perforations.
  - c. NPS 10 and larger: Stainless-steel basket with 5/32 inch perforations.
4. Minimum Working Pressure and Operating Temperature: 150 psig at 220 deg F, unless otherwise indicated in Division 23 "Hydronic Piping".

B. Basket Strainers:

1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen:
  - a. NPS 2 and smaller: Stainless-steel 20-mesh screen.
  - b. NPS 2-1/2 to NPS 8: Stainless-steel basket with 1/8 inch perforations.
  - c. NPS 10 and larger: Stainless-steel basket with 5/32 inch perforations.
4. Minimum Working Pressure and Operating Temperature: 150 psig at 220 deg F, unless otherwise indicated in Division 23 "Hydronic Piping".

C. Stainless-Steel Bellow, Flexible Connectors:

1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
2. End Connections: Threaded or flanged to match equipment connected.
3. Performance: Capable of 3/4-inch misalignment.
4. Minimum Working Pressure and Operating Temperature: 150 psig at 220 deg F, unless otherwise indicated in Division 23 "Hydronic Piping".

D. Expansion Fittings: Comply with requirements in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

### **PART 3 - EXECUTION**

#### **3.1 VALVE APPLICATIONS**

- A. Install shutoff-duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.
- B. Install calibrated-orifice, balancing valves at each branch connection to return main.
- C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.
- D. Calibrated-orifice balancing valves shall not be utilized for shutoff service. At each balancing valve, provide a separate shut-off valve.
- E. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- F. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.
- G. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

#### **3.2 HYDRONIC SPECIALTIES INSTALLATION**

- A. Outside of mechanical rooms, install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- B. Inside mechanical rooms, install automatic air vents at high points of system piping in mechanical equipment rooms only. Install manual vents at heat-transfer coils and elsewhere as required for air venting.
- C. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.
- D. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 (DN 50) and larger.
- E. Install tangential air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.
- F. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure that tank is properly charged with air to suit system Project requirements.

**END OF SECTION 232116**

## **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. Vertical in-line centrifugal pumps.
  - 2. Automatic condensate pump units.

### **1.3 DEFINITIONS**

- A. Buna-N: Nitrile rubber.
- B. EPT: Ethylene propylene terpolymer.

### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of pump. Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.
- B. Shop Drawings: For each pump.
  - 1. Show pump layout and connections.
  - 2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
  - 3. Include diagrams for power, signal, and control wiring.

### **1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

### **1.6 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Mechanical Seals: One mechanical seal(s) for each pump.

## **PART 2 - PRODUCTS**

### **2.1 VERTICAL IN-LINE CENTRIFUGAL PUMPS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Armstrong (Basis of Design)
  - 2. Bell & Gossett
  - 3. Taco
- B. Description: Single stage, single suction type, vertical inline pump.
  - 1. Seals: Close-coupled serviceable without disturbing piping connections.
  - 2. Include casing drain plug and 1/4 inch suction and discharge ports.
- C. Pump Construction:
  - 1. Casing: Cast iron ASTM A48, E-coated.

- a. Test casing to 150 % maximum working pressure.
    - b. Ensure casing is radially split to allow for removal of rotating element without disturbing pipe connections.
    - c. Drill and tap casing for gauge ports on both suction and discharge connections.
    - d. Drill and tap casing on bottom for drain port.
  2. Impeller: To ASTM B584, bronze, fully enclosed and dynamically balanced to ANSI G6.3 and fitted to shaft with key. Use two-plane balancing when installed impeller diameter is less than 6 times impeller width.
  3. Pump Shafts:
    - a. Shaft Sleeve: Brass to ASTM B111.687.
  4. Flanges: To ANSI/ASME B16.5, Class 250.
  5. Flush Line: 3/8 inch braided stainless steel complete with vent.
  6. Gasket: Synthetic fiber.
  7. Mechanical Seal: Non-Potable Fluid, Type Armstrong 2A, Inside Single Spring and rated to 230°F maximum.
    - a. Rotating face: Resin Bonded Carbon.
    - b. Stationary seat: Sintered Silicone carbide.
- D. Motor: NEMA Premium® Motor: To ANSI/NEMA MG 1
1. Enclosure: ODP.
  2. Efficiency: NEMA Premium 12.12.
  3. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  4. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

## **2.2 AUTOMATIC CONDENSATE PUMP UNITS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hartell Pumps Div.; Milton Roy Co.
  2. Beckett Corporation.
  3. Little Giant Pump Co.
  4. Mepco, LLC.
- B. Description: Packaged units with corrosion-resistant pump, plenum rated non-combustible material tank with cover, and automatic controls. Include factory- or field-installed check valve and a 72-inch- minimum, hardwired electrical power.

## **2.3 PUMP SPECIALTY FITTINGS**

- A. Triple-Duty Valves shall not be permitted. Provide a separate balancing valve, check valve, and shutoff valve for each pump.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
- C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PUMP INSTALLATION**

- A. Comply with HI 1.4.

- B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.
- C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
- D. Automatic Condensate Pump Units: Install units for collecting condensate and extend to open drain.
- E. Equipment Mounting:
  - 1. Install base-mounted pumps on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Division 03 Section "Cast-in-Place Concrete."
  - 2. Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration Controls for HVAC."

### **3.3 ALIGNMENT**

- A. Engage a factory-authorized service representative to perform alignment service.
- B. Comply with requirements in Hydronics Institute standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.
- C. Comply with pump and coupling manufacturers' written instructions.
- D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

### **3.4 CONNECTIONS**

- A. Comply with requirements for piping specified in Division 23 Section "General Duty Valves for Hydronic Piping", Division 23 Section "Hydronic Piping" and Division 23 Section "Hydronic Piping Specialties". Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to pump, allow space for service and maintenance.
- C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.
- D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- E. Install check, shutoff, and balancing valves on discharge side of pumps.
- F. Install Y-type strainer or suction diffuser and shutoff valve on suction side of pumps.
- G. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.
- H. Install pressure gages on pump suction and discharge or at integral pressure-gage tapping, or install single gage with multiple-input selector valve.
- I. Install check valve and butterfly or ball valve on each condensate pump unit discharge.
- J. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- K. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

**3.5      STARTUP SERVICE**

- A.      Engage a factory-authorized service representative to perform startup service.
  - 1.      Complete installation and startup checks according to manufacturer's written instructions.
  - 2.      Check piping connections for tightness.
  - 3.      Clean strainers on suction piping.
  - 4.      Perform the following startup checks for each pump before starting:
    - a.      Verify bearing lubrication.
    - b.      Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
    - c.      Verify that pump is rotating in the correct direction.
  - 5.      Prime pump by opening suction valves and closing drains, and prepare pump for operation.
  - 6.      Start motor.
  - 7.      Open discharge valve slowly.

**3.6      DEMONSTRATION**

- A.      Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.

**END OF SECTION 232123**

## **PART 1 - GENERAL**

### **1.1 RELATED DOCUMENTS**

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

### **1.2 SUMMARY**

- A. This Section includes refrigerant piping used for air-conditioning applications.

### **1.3 PERFORMANCE REQUIREMENTS**

- A. Line Test Pressure for Refrigerant R-410A:
  - 1. Suction Lines for Air-Conditioning Applications: 300 psig.
  - 2. Suction Lines for Heat-Pump Applications: 535 psig.
  - 3. Hot-Gas and Liquid Lines: 535 psig.

### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for the following:
  - 1. Thermostatic expansion valves.
  - 2. Solenoid valves.
  - 3. Hot-gas bypass valves.
  - 4. Filter dryers.
  - 5. Strainers.
  - 6. Pressure-regulating valves.
- B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.
  - 1. Shop Drawing Scale: 3/8 inch equals 1 foot.
  - 2. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

### **1.5 INFORMATIONAL SUBMITTALS**

- A. Field quality-control test reports.

### **1.6 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

### **1.7 QUALITY ASSURANCE**

- A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

**1.8 PRODUCT STORAGE AND HANDLING**

- A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

**1.9 COORDINATION**

- A. Coordinate size and location of roof curbs, equipment supports, and roof penetrations.

**PART 2 - PRODUCTS**

**2.1 COPPER TUBE AND FITTINGS**

- A. Copper Tube: ASTM B88 Type L or ASTM B280 Type ACR.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- E. Brazing Filler Metals: AWS A5.8.
- F. Flexible Connectors:
  - 1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
  - 2. End Connections: Socket ends.
  - 3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch- long assembly.
  - 4. Pressure Rating: Factory test at minimum 500 psig.
  - 5. Maximum Operating Temperature: 250 deg F.

**2.2 VALVES AND SPECIALTIES**

- A. Diaphragm Packless Valves:
  - 1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
  - 2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
  - 3. Operator: Rising stem and hand wheel.
  - 4. Seat: Nylon.
  - 5. End Connections: Socket, union, or flanged.
  - 6. Working Pressure Rating: 500 psig.
  - 7. Maximum Operating Temperature: 275 deg F.
- B. Packed-Angle Valves:
  - 1. Body and Bonnet: Forged brass or cast bronze.
  - 2. Packing: Molded stem, back seating, and replaceable under pressure.
  - 3. Operator: Rising stem.
  - 4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
  - 5. Seal Cap: Forged-brass or valox hex cap.
  - 6. End Connections: Socket, union, threaded, or flanged.
  - 7. Working Pressure Rating: 500 psig.
  - 8. Maximum Operating Temperature: 275 deg F.
- C. Check Valves:
  - 1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.



2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
3. Piston: Removable polytetrafluoroethylene seat.
4. Closing Spring: Stainless steel.
5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
6. End Connections: Socket, union, threaded, or flanged.
7. Maximum Opening Pressure: 0.50 psig.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 275 deg F.

D. Service Valves:

1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Copper spring.
5. Working Pressure Rating: 500 psig.

E. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.

1. Body and Bonnet: Plated steel.
2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 24 VAC coil.
6. Working Pressure Rating: 400 psig.
7. Maximum Operating Temperature: 240 deg F.
8. Manual operator.

F. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.

1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
2. Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Seat Disc: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Working Pressure Rating: 400 psig.
6. Maximum Operating Temperature: 240 deg F.

G. Straight-Type Strainers:

1. Body: Welded steel with corrosion-resistant coating.
2. Screen: 100-mesh stainless steel.
3. End Connections: Socket or flare.
4. Working Pressure Rating: 500 psig.
5. Maximum Operating Temperature: 275 deg F.

H. Angle-Type Strainers:

1. Body: Forged brass or cast bronze.
2. Drain Plug: Brass hex plug.
3. Screen: 100-mesh monel.
4. End Connections: Socket or flare.
5. Working Pressure Rating: 500 psig.
6. Maximum Operating Temperature: 275 deg F.

I. Moisture/Liquid Indicators:

1. Body: Forged brass.
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in ppm.

4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 240 deg F.

J. Replaceable-Core Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated charcoal.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig.
8. Rated Flow: Refer to drawings for unit tonnages.
9. Working Pressure Rating: 500 psig.
10. Maximum Operating Temperature: 240 deg F.

K. Permanent Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated charcoal.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig.
8. Rated Flow: Refer to drawings for unit tonnages.
9. Working Pressure Rating: 500 psig.
10. Maximum Operating Temperature: 240 deg F.

L. Mufflers:

1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or flare.
3. Working Pressure Rating: 500 psig.
4. Maximum Operating Temperature: 275 deg F.

M. Receivers: Comply with ARI 495.

1. Comply with UL 207; listed and labeled by an NRTL.
2. Body: Welded steel with corrosion-resistant coating.
3. Tappings: Inlet, outlet, liquid level indicator, and safety relief valve.
4. End Connections: Socket or threaded.
5. Working Pressure Rating: 500 psig.
6. Maximum Operating Temperature: 275 deg F.

N. Liquid Accumulators: Comply with ARI 495.

1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or threaded.
3. Working Pressure Rating: 500 psig.
4. Maximum Operating Temperature: 275 deg F.

## 2.3 REFRIGERANTS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Atofina Chemicals, Inc.
2. DuPont Company; Fluorochemicals Div.

3. Honeywell, Inc.; Genetron Refrigerants.
4. INEOS Fluor Americas LLC.

B. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

### **PART 3 - EXECUTION**

#### **3.1 PIPING APPLICATIONS FOR REFRIGERANT R-410A**

- A. Suction Lines for Conventional Air-Conditioning Applications: Copper, Type ACR or L, drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
- B. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR or L, drawn-temper tubing and wrought-copper fittings with Alloy HB soldered joints.
- C. Safety-Relief-Valve Discharge Piping: Copper, Type ACR or L, annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.

#### **3.2 VALVE AND SPECIALTY APPLICATIONS**

- A. Install valves and specialties for each DX split air conditioning unit or heat pump in accordance with manufacturer's guidelines and recommendations.

#### **3.3 PIPING INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Refer to Division 23 Section "Instrumentation and Control for HVAC" and Division 23 Section "Sequence of Operations for HVAC Controls" for solenoid valve controllers, control wiring, and sequence of operation.
- K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 08 Section "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.

- M. Install refrigerant piping in protective conduit where installed belowground.
- N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- O. 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.
- P. 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.
- Q. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- R. Identify refrigerant piping and valves according to Division 23 Section "Identification for HVAC Piping and Equipment."
- S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."
- T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 23 Section "Escutcheons for HVAC Piping."

### **3.4 PIPE JOINT CONSTRUCTION**

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
- D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
  - 1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
  - 2. Use Type BA<sub>g</sub>, cadmium-free silver alloy for joining copper with bronze or steel.
- E. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

### **3.5 HANGERS AND SUPPORTS**

- A. Hanger, support, and anchor products are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Install the following pipe attachments:
  - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
  - 2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
  - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
  - 4. Spring hangers to support vertical runs.
  - 5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4 inch.
2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.
3. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.
4. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.
5. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
6. NPS 2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
7. NPS 2-1/2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
8. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
9. NPS 4: Maximum span, 12 feet; minimum rod size, 1/2 inch.

D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
2. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
3. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
4. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.

E. Support multi-floor vertical runs at least at each floor.

**3.6 FIELD QUALITY CONTROL**

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
  - a. Fill system with nitrogen to the required test pressure.
  - b. System shall maintain test pressure at the manifold gage throughout duration of test.
  - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
  - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

**3.7 SYSTEM CHARGING**

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
4. Charge system with a new filter-dryer core in charging line as per the manufacturers recommendations.

**3.8 ADJUSTING**

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:

1. Open shutoff valves in condenser water circuit.
  2. Verify that compressor oil level is correct.
  3. Open compressor suction and discharge valves.
  4. Open refrigerant valves except bypass valves that are used for other purposes.
  5. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

**END OF SECTION 232300**

## **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 the following water treatment for closed-loop hydronic systems:

1. Manual and automatic chemical-feed equipment.
2. Chemicals.

### **1.3 DEFINITIONS**

- A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
- B. RO: Reverse osmosis.
- C. TSS: Total suspended solids are solid materials, including organic and inorganic, that are suspended in the water. These solids may include silt, plankton, and industrial wastes.

### **1.4 ACTION SUBMITTALS**

- A. Product Data: Include rated capacities, operating characteristics, and furnished specialties and accessories for the following products:
  1. Bypass feeders.
  2. Chemical test equipment.
  3. Chemical material safety data sheets.
- B. Shop Drawings: Pretreatment and chemical treatment equipment showing tanks, maintenance space required, and piping connections to hydronic systems.
  1. Include plans, elevations, sections, and attachment details.
  2. Include diagrams for power, signal, and control wiring.

### **1.5 INFORMATIONAL SUBMITTALS**

- A. Water Analysis Provider Qualifications: Verification of experience and capability of HVAC water-treatment service provider.
- B. Field quality-control reports.
- C. Other Informational Submittals:
  1. Water-Treatment Program: Written sequence of operation on an annual basis for the application equipment required to achieve water quality defined in "Performance Requirements" Article.
  2. Water Analysis: Illustrate water quality available at Project site.

### **1.6 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For sensors, injection pumps, and controllers to include in emergency, operation, and maintenance manuals.

**1.7 QUALITY ASSURANCE**

- A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.

**1.8 MAINTENANCE SERVICE**

- A. Scope of Maintenance Service: Provide chemicals and service program to maintain water conditions required above to inhibit corrosion and scale formation for hydronic piping and equipment. Services and chemicals shall be provided for a period of one year from date of Substantial Completion and shall include the following:
1. Initial water analysis and HVAC water-treatment recommendations.
  2. Startup assistance for Contractor to flush the systems, clean with detergents, and initially fill systems with required chemical treatment prior to operation.
  3. Periodic field service and consultation.
  4. Customer report charts and log sheets.
  5. Laboratory technical analysis.
  6. Analyses and reports of all chemical items concerning safety and compliance with government regulations.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ampion Corp.
  2. Anderson Chemical Company.
  3. Aqua-Chem, Inc.
  4. Barclay Water Management, Inc.
  5. Boland.
  6. Cascade Water Services, Inc.
  7. Earthwise Environmental Inc.
  8. General Electric Company; GE Water & Process Technologies.
  9. H-O-H Water Technology, Inc.
  10. Metro Group, Inc. (The); Metropolitan Refining Div.
  11. Nalco; an Ecolab company.
  12. Watcon, Inc.
  13. Water Services Inc.
  14. Approved equal.

**2.2 PERFORMANCE REQUIREMENTS**

- A. Water quality for hydronic systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of hydronic equipment without creating a hazard to operating personnel or the environment.
- B. Base HVAC water treatment on quality of water available at Project site, hydronic system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.
- C. Closed hydronic systems, including hot-water heating and chilled water, shall have the following water qualities:
1. pH: Maintain a value within 9.0 to 10.5.
  2. "P" Alkalinity: Maintain a value within 100 to 500 ppm.
  3. Boron: Maintain a value within 100 to 200 ppm.
  4. Chemical Oxygen Demand: Maintain a maximum value of 100 ppm.
  5. Soluble Copper: Maintain a maximum value of 0.20 ppm.
  6. TSS: Maintain a maximum value of 10 ppm.
  7. Ammonia: Maintain a maximum value of 20 ppm.
  8. Free Caustic Alkalinity: Maintain a maximum value of 20 ppm.



9. Microbiological Limits:
  - a. Total Aerobic Plate Count: Maintain a maximum value of 1000 organisms/mL.
  - b. Total Anaerobic Plate Count: Maintain a maximum value of 100 organisms/mL.
  - c. Nitrate Reducers: Maintain a maximum value of 100 organisms/mL.
  - d. Sulfate Reducers: Maintain a maximum value of zero organisms/mL.
  - e. Iron Bacteria: Maintain a maximum value of zero organisms/mL.

### **2.3 MANUAL CHEMICAL-FEED EQUIPMENT**

- A. Bypass Feeders: Steel, with corrosion-resistant exterior coating, minimum 3-1/2-inch (89-mm) fill opening in the top, and NPS 3/4 (DN 20) bottom inlet and top side outlet. Quarter turn or threaded fill cap with gasket seal and diaphragm to lock the top on the feeder when exposed to system pressure in the vessel.
  1. Capacity: 5 gal. (19 L).
  2. Minimum Working Pressure: 175 psig (1210 kPa).

### **2.4 CHEMICALS**

- A. Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment and that can attain water quality specified in "Performance Requirements" Article.

## **PART 3 - EXECUTION**

### **3.1 WATER ANALYSIS**

- A. Perform an analysis of supply water to determine quality of water available at Project site.

### **3.2 INSTALLATION**

- A. Install chemical application equipment on concrete bases, level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor chemical tanks and floor-mounting accessories to substrate.
- B. Install water testing equipment on wall near water chemical application equipment.
- C. Bypass Feeders: Install in closed hydronic systems, including hot-water heating and chilled water, and equipped with the following:
  1. Install bypass feeder in a bypass circuit around circulating pumps unless otherwise indicated on Drawings.
  2. Install water meter in makeup-water supply.
  3. Install test-coupon assembly in bypass circuit around circulating pumps unless otherwise indicated on Drawings.
  4. Install a gate or full-port ball isolation valves on inlet, outlet, and drain below the feeder inlet.
  5. Install a swing check on the inlet after the isolation valve.

### **3.3 CONNECTIONS**

- A. Where installing piping adjacent to equipment, allow space for service and maintenance.
- B. Make piping connections between HVAC water-treatment equipment and dissimilar-metal piping with dielectric fittings. Comply with requirements in Division 23 Section "Hydronic Piping Specialties."
- C. Install shutoff valves on HVAC water-treatment equipment inlet and outlet. Metal general-duty valves are specified in Division 23 Section "General-Duty Valves for HVAC Piping."
- D. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for backflow preventers required in makeup-water connections to potable-water systems.

### **3.4 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
  - 1. Inspect field-assembled components and equipment installation, including piping and electrical connections.
  - 2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
  - 3. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
  - 4. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  - 5. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
  - 6. 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 test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
  - 7. Repair leaks and defects with new materials and retest piping until no leaks exist.
- B. Equipment will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.
- D. At four-week intervals following Substantial Completion, perform separate water analyses on hydronic systems to show that automatic chemical-feed systems are maintaining water quality within performance requirements specified in this Section. Submit written reports of water analysis advising Owner of changes necessary to adhere to "Performance Requirements" Article.
- E. Comply with ASTM D 3370 and with the following standards:
  - 1. Silica: ASTM D 859.
  - 2. Acidity and Alkalinity: ASTM D 1067.
  - 3. Iron: ASTM D 1068.
  - 4. Water Hardness: ASTM D 1126.

### **3.5 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment.

**END OF SECTION 232513**

## **PART 1 - GENERAL**

### **1.1 RELATED DOCUMENTS**

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

### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Single-wall rectangular ducts and fittings.
  - 2. Double-wall rectangular ducts and fittings.
  - 3. Single-wall round and flat-oval ducts and fittings.
  - 4. Double-wall round and flat-oval ducts and fittings.
  - 5. Sheet metal materials.
  - 6. Duct liner.
  - 7. Sealants and gaskets.
  - 8. Hangers and supports.
- B. Related Sections:
  - 1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
  - 2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

### **1.3 REFERENCE STANDARDS**

- A. ASTM International (ASTM).
- B. American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc. (ASHRAE).
- C. North American Insulation Manufacturers Association (NAIMA).
- D. National Fire Protection Association (NFPA).
- E. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA).
- F. Underwriters Laboratories (UL).
- G. Underwriters Laboratories Environmental (UL Environment).

### **1.4 DEFINITIONS**

- A. Thermal Conductivity (K value): Units of Btu-inch/hour per square foot per degree F.
- B. UL GREENGUARD: Provides independent third-party, Indoor Air Quality (IAQ) certification of products for emissions of respirable particles and Volatile Organic Compounds (VOC's), including formaldehyde and other specific product-related pollutants. Certification is based upon criteria used by EPA, OSHA, and WHO.
- C. EPA: Environmental Protection Agency.
- D. WHO: World Health Organization.
- E. ASJ+: All Service Jacket composed of aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film layer leaving no paper exposed.

- F. ASJ: All Service Jacket (no outer film).
- G. SSL+: Self-Sealing Lap with Advanced Closure System.
- H. SSL: Self-Sealing Lap.
- I. FSK: Foil Scrim Kraft; jacketing.
- J. PSK: Poly Scrim Kraft; jacketing.
- K. PVC: Polyvinyl Chloride.
- L. Glass Mineral Wool: Interchangeable with fiber glass, but replacing the term in the attempt to disassociate and differentiate Glass Mineral Wool from the potential health and safety risk of special purpose or reinforcement products that do not meet the bio solubility criteria of insulation made from glass. Rock Mineral Wool will replace the traditional Mineral Wool label. Both are used in lieu of the Mineral Fiber label.
- M. ECOSE Technology: a revolutionary new binder system based on rapidly renewable bio-based materials; rather than petroleum-based chemicals commonly used in other glass mineral wool insulation materials. ECOSE Technology reduces the binder embodied energy by up to 70 percent and does not contain phenol, formaldehyde, acrylics or artificial colors.
- N. UL GREENGUARD Gold Certification: (formerly known as GREENGUARD Children & Schools Certification) offers stricter certification criteria, considers safety factors to account for sensitive individuals (such as children and the elderly), and ensures that a product is acceptable for use in environments such as schools and healthcare facilities. It is referenced by both The Collaborative for High Performance Schools (CHPS) and the Leadership in Energy Environmental Design (LEED) Building Rating Systems.
- O. UL Environment Formaldehyde Free Verification Requirements: For a product to be verified as formaldehyde free, product samples must have a measured emission factor of less than or equal to 5 µg/m²h at 24 elapsed hours or 3 µg/m²h at 336 elapsed hours. An emission factor of 5 µg/m²h corresponds to measured chamber concentration of 2.5 µg/m³ for a typical building ratio of 0.5 m²/m³. This chamber concentration is comparable to, or below typical outdoor air concentrations. This demonstrates that the formaldehyde exposure from products labeled as formaldehyde free will not contribute to airborne formaldehyde concentrations at greater levels than those found in the natural outdoor environment.

#### **1.5 PERFORMANCE REQUIREMENTS**

- A. Performance-Based Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE/SEI 7.
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

#### **1.6 ACTION SUBMITTALS**

- A. Product Data: For each type of the following products:
  - 1. Liners and adhesives.
  - 2. Sealants and gaskets.
- B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, and vibration isolation.

#### **1.7 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Duct installation in indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
  2. Suspended ceiling components.
  3. Structural members to which duct will be attached.
  4. Size and location of initial access modules for acoustical tile.
  5. Penetrations of smoke barriers and fire-rated construction.
  6. Items above finished ceiling including the following:
    - a. Lighting fixtures.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Sprinkler System.
    - e. Plumbing piping and equipment.
    - f. Electrical Equipment and conduit.
    - g. Building Structure.
    - h. Access panels.
    - i. Perimeter moldings.
- B. Welding certificates.
- C. Field quality-control reports.

#### **1.8 QUALITY ASSURANCE**

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
  2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
  3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
- D. Surface Burning Characteristics: For insulation and related materials, UL/ULC Classified per UL 723 or meeting ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
- E. Insulation Installed Indoors: Flame spread index of 25 or less, and smoke developed index of 50 or less.

- F. Insulation Installed Outdoors: Flame spread index of 75 or less, and smoke developed index of 150 or less.
- G. Formaldehyde Free Third Party certified with UL Environmental Validation.
- H. Biosoluble: As determined by research conducted by the International Agency for Research on Cancer (IARC) and supported by revised reports from the National Toxicology Program (NTP) and the California Office of Environmental Health Hazard Assessment. Certified by European Certification Board for Mineral Wool Products (EUCB).
- I. Recycled Content: A minimum of 50 percent Post-Consumer recycled glass content certified and UL Validated.
- J. Low Emitting Materials: For all thermal and acoustical applications of Glass Mineral Wool Insulation Products, provide materials complying with the testing and products requirements of UL GREENGUARD Gold Certification.
- K. Living Building Challenge - Declare Red List Free.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. Ductwork less than 26 gauge shall not be used on this project.

### **2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS**

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

### **2.3 SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS**

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Lindab Inc.
    - b. McGill AirFlow LLC.
    - c. SEMCO Incorporated.
    - d. Sheet Metal Connectors, Inc.
    - e. Spiral Manufacturing Co., Inc.
- B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

- C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
  2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
- E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## **2.4 DOUBLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Lindab Inc.
  2. McGill AirFlow LLC.
  3. SEMCO Incorporated.
  4. Sheet Metal Connectors, Inc.
- B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.
- C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.
1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
    - a. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
  2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
    - a. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
    - b. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
  3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having 3/32-inch- diameter perforations, with overall open area of 23 percent.

- E. Insulation for use in Double Wall Spiral Duct; UL/ULC Classified per UL 723; maximum service temperature 650° F (271° C) per ASTM C 411; complying with requirements of ASTM C 553; Type I and Type II; and does not support the growth of mold, fungi, or bacteria per ASTM C 1338. UL GREENGUARD Gold certified and UL Environment Validated to be formaldehyde free.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Knauf Insulation; KN Series with ECOSE Technology.

## **2.5 SHEET METAL MATERIALS**

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
1. Galvanized Coating Designation: G60.
  2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.
- E. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- F. Factory- or Shop-Applied Antimicrobial Coating:
1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating shall be applied to the exterior surface.
  2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
  3. Coating containing the antimicrobial compound shall have a hardness of 2H, minimum, when tested according to ASTM D 3363.
  4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
  5. Shop-Applied Coating Color: Black.
  6. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.
- G. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- H. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

## **2.6 DUCT LINER**

- A. Glass Mineral Wool Duct Liner: UL/ULC Classified per UL 723. Comply with ASTM C 1071 Type I and Type II, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard." UL GREENGUARD Certified; does not support the growth of mold, fungi or bacteria per ASTM C 1338.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Johns Manville; Linacoustic RC
    - b. Knauf Insulation; Sonic XP Duct Liner with ECOSE Technology or Rigid Plenum Liner with ECOSE Technology
    - c. CertainTeed Corporation; Insulation Group.



- d. Owens Corning.
    - d. Maximum Thermal Conductivity:
      - 1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
      - 2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
  - 2. Duct Liners meet ASTM C 1338 by applying an EPA registered anti-microbial agent to aid in the prevention of fungal and bacterial growth. The addition of a coating as suggested above MAY affect the FHC Classification of the product
  - 3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
  - 4. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
    - a. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
    - b. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Insulation Pins and Washers:
- 1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch - diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
  - 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
- 1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
  - 2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
  - 3. Butt transverse joints without gaps, and coat joint with adhesive.
  - 4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
  - 5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
  - 6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
  - 7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
  - 8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
    - a. Fan discharges.
    - b. Intervals of lined duct preceding unlined duct.
    - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
  - 9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
    - a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.

10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

## **2.7 SEALANT AND GASKETS**

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
  1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
  2. Tape Width: 4 inches.
  3. Sealant: Modified styrene acrylic.
  4. Water resistant.
  5. Mold and mildew resistant.
  6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
  7. Service: Indoor and outdoor.
  8. Service Temperature: Minus 40 to plus 200 deg F.
  9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
  10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  11. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Water-Based Joint and Seam Sealant:
  1. Application Method: Brush on.
  2. Solids Content: Minimum 65 percent.
  3. Shore A Hardness: Minimum 20.
  4. Water resistant.
  5. Mold and mildew resistant.
  6. VOC: Maximum 75 g/L (less water).
  7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
  8. Service: Indoor or outdoor.
  9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- D. Solvent-Based Joint and Seam Sealant:
  1. Application Method: Brush on.
  2. Base: Synthetic rubber resin.
  3. Solvent: Toluene and heptane.
  4. Solids Content: Minimum 60 percent.
  5. Shore A Hardness: Minimum 60.
  6. Water resistant.
  7. Mold and mildew resistant.
  8. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  9. VOC: Maximum 395 g/L.
  10. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
  11. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
  12. Service: Indoor or outdoor.
  13. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

- E. Flanged Joint Sealant: Comply with ASTM C 920.
  - 1. General: Single-component, acid-curing, silicone, elastomeric.
  - 2. Type: S.
  - 3. Grade: NS.
  - 4. Class: 25.
  - 5. Use: O.
  - 6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- G. Round Duct Joint O-Ring Seals:
  - 1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
  - 2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
  - 3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

## **2.8 HANGERS AND SUPPORTS**

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
  - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
  - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
  - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

## **PART 3 - EXECUTION**

### **3.1 DUCT INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

- C. Install round and flat-oval ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

### **3.2 INSTALLATION OF EXPOSED DUCTWORK**

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

### **3.3 DUCT SEALING**

- A. Ductwork shall be constructed and erected in accordance with the following.
  - 1. Low Pressure Ductwork Systems – All longitudinal and transverse joints, seams and connections of supply and return ducts operating at a static pressure less than or equal to 2-inches w.g. shall be securely fastened and sealed with welds, gaskets, mastics, mastic plus embedded fabric systems or tapes installed in accordance with the manufacturer's installation instructions.
  - 2. Medium Pressure Duct Systems – All ducts and plenums operating at a static pressure greater than 2-inches w.g. but less than 3-inches w.g. shall be insulated and sealed as per the schedule below.
  - 3. High Pressure Duct Systems – Ducts designed to operate at a static pressure greater than 3-inches w.g. shall be insulated and sealed as per the schedule below.
- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and the following:
  - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 2. Outdoor, Supply-Air Ducts: Seal Class A.

3. Outdoor, Exhaust Ducts: Seal Class C.
4. Outdoor, Return-Air Ducts: Seal Class C.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class C.
8. Unconditioned Space, Return-Air Ducts: Seal Class B.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

### **3.4 HANGER AND SUPPORT INSTALLATION**

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  1. Where practical, install concrete inserts before placing concrete.
  2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
  4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### **3.5 CONNECTIONS**

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

### **3.6 PAINTING**

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 Section "Exterior Painting" and Division 09 Section "Interior Painting."

### **3.7 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test. Submit duct drawings clearly identifying each section of ductwork tested with numbering corresponding to test results for that section.

Rate of air leakage (CL) must be less than or equal to 6.0 as determined in accordance with the equation below:

$$CL = F/P^{0.65}$$

where:

F = The measured leakage rate in cfm per 100 square feet of duct surface.

P = The static pressure of the test.

2. Test the following systems:
  - a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections, totaling no less than 25 percent of total installed duct area for each designated pressure class.
  - b. Ducts located outdoors, all pressure classes: Test representative duct sections, totaling no less than 25 percent of total installed duct area for each designated pressure class.
3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Test for leaks before applying external insulation.
5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
6. Give seven days' advance notice to Engineer and Commissioning Authority for testing.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
  - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

**3.8 DUCT CLEANING**

A. Clean new duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 23 Section "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

**3.9 START UP**

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC" and ASHRAE 62.1 Section 7 - "Construction and System Start-up."

**3.10 DUCT SCHEDULE**

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
1. Provide aluminum construction for all ducts and plenums exposed to weather and moisture, including outside air and exhaust ducts within 10 feet of louvers.
- B. Pressure class of all ductwork shall equal or exceed the design pressure of the air distribution system where used. Refer to equipment schedules on drawings for air handling unit and fan external static pressure (ESP) values.
- C. Supply Ducts:
1. Pressure classes shall be as follows:
    - a. Pressure Class: 2-inch wg (Positive).
      - 1) Minimum SMACNA Seal Class: See article "DUCT SEALING" for requirements.
      - 2) SMACNA Leakage Class for Rectangular: 24.
      - 3) SMACNA Leakage Class for Round and Flat Oval: 12.
      - 4) Where used:
        - a) All supply ductwork, unless otherwise noted or connected to a higher static pressure duct system.
    - b. Pressure Class: 3-inch wg (Positive).
      - 1) Minimum SMACNA Seal Class: See article "DUCT SEALING" for requirements.
      - 2) SMACNA Leakage Class for Rectangular: 12.

- 3) SMACNA Leakage Class for Round and Flat Oval: 6.
- 4) Where used:
  - a) All supply ductwork for systems with design pressure 2-3 inch w.g., unless otherwise noted.

c. Pressure Class: 4-inch wg (Positive).

- 1) Minimum SMACNA Seal Class: See article "DUCT SEALING" for requirements.
- 2) SMACNA Leakage Class for Rectangular: 6.
- 3) SMACNA Leakage Class for Round and Flat Oval: 3.
- 4) Where used:
  - a) All supply ductwork for systems with design pressure 3-4 inch w.g.
  - b) All supply ductwork from discharge of air handling units to inlets of terminal boxes.
  - c) All supply ductwork located outdoors.
  - d) All supply ductwork located within 20 feet of the inlet of an air handling unit over 2000 CFM or its associated return fan.

D. Return Ducts:

1. Pressure classes shall be as follows:

a. Pressure Class: 2-inch wg (Positive or negative).

- 1) Minimum SMACNA Seal Class: See article "DUCT SEALING" for requirements.
- 2) SMACNA Leakage Class for Rectangular: 24.
- 3) SMACNA Leakage Class for Round and Flat Oval: 12.
- 4) Where used:
  - a) All return ductwork, unless otherwise noted or connected to a higher static pressure duct system.

b. Pressure Class: 3-inch wg (Positive or negative).

- 1) Minimum SMACNA Seal Class: See article "DUCT SEALING" for requirements.
- 2) SMACNA Leakage Class for Rectangular: 12.
- 3) SMACNA Leakage Class for Round and Flat Oval: 6.
- 4) Where used:
  - a) All return ductwork for systems with design pressure 2-3 inch w.g., unless otherwise noted.

c. Pressure Class: 4-inch wg (Positive or negative).

- 1) All return ductwork for systems with design pressure 3-4 inch w.g.
- 2) Minimum SMACNA Seal Class: See article "DUCT SEALING" in this specification for requirements.
- 3) SMACNA Leakage Class for Rectangular: 6.
- 4) SMACNA Leakage Class for Round and Flat Oval: 3.
- 5) Where used:
  - a) All return ductwork for systems with design pressure 3-4 inch w.g.
  - b) All return ductwork located outdoors.
  - c) All return ductwork located within 20 feet of the inlet of an air handling unit over 2000 CFM or its associated return fan.

E. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

a. Pressure Class: 3-inch wg (Positive or negative).

- 1) Minimum SMACNA Seal Class: See article "DUCT SEALING" in this specification for requirements.
- 2) SMACNA Leakage Class for Rectangular: 12.
- 3) SMACNA Leakage Class for Round and Flat Oval: 6.
- 4) Where used:
  - a) All exhaust and relief air ductwork, unless otherwise noted or connected to a higher static pressure duct system.



- b. Pressure Class: Positive 4-inch wg.
  - 1) Minimum SMACNA Seal Class: A.
  - 2) SMACNA Leakage Class for Rectangular: 6.
    - a) SMACNA Leakage Class for Round and Flat Oval: 3.
  - 3) Where used:
    - a) All exhaust and relief air ductwork for systems with design pressure 3-4 inch w.g.

F. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:

- a. Pressure Class: 2-inch wg (Positive or negative).
  - 1) Minimum SMACNA Seal Class: See article "DUCT SEALING" for requirements.
  - 2) SMACNA Leakage Class for Rectangular: 24.
  - 3) SMACNA Leakage Class for Round and Flat Oval: 12.
  - 4) Where used:
    - a) All outside air intake ductwork, unless otherwise noted or connected to a higher static pressure duct system.
- b. Pressure Class: 3-inch wg (Positive or negative).
  - 1) Minimum SMACNA Seal Class: See article "DUCT SEALING" for requirements.
  - 2) SMACNA Leakage Class for Rectangular: 12.
  - 3) SMACNA Leakage Class for Round and Flat Oval: 6.
  - 4) Where used:
    - a) All outside air intake ductwork for systems with design pressure 2-3 inch w.g., unless otherwise noted.
    - b) All outside air intake ductwork located outdoors.
    - c) All outside air intake ductwork from louver to the inlet of an air handling units over 2000 CFM or its associated return fan.
- c. Pressure Class: 4-inch wg (Positive or negative).
  - 1) All return ductwork for systems with design pressure 3-4 inch w.g.
  - 2) Minimum SMACNA Seal Class: See article "DUCT SEALING" in this specification for requirements.
  - 3) SMACNA Leakage Class for Rectangular: 6.
  - 4) SMACNA Leakage Class for Round and Flat Oval: 3.
  - 5) Where used:
    - a) All outside air intake ductwork for systems with design pressure 3-4 inch w.g.

G. Intermediate Reinforcement:

- 1. Galvanized-Steel Ducts: Galvanized steel.
- 2. PVC-Coated Ducts:
  - a. Exposed to Airstream: Match duct material.
  - b. Not Exposed to Airstream: Match duct material.
- 3. Stainless-Steel Ducts:
  - a. Exposed to Airstream: Match duct material.
  - b. Not Exposed to Airstream: Match duct material.
- 4. Aluminum Ducts: Aluminum.

H. Liner:

- 1. Provide acoustically lined duct where listed below and/or as shown on the drawings:
  - a. All transfer ducts.
  - b. Within a minimum of 20 feet of all AC unit discharges.

- c. Within a minimum of 20 feet of fan inlet and discharges.
    - d. Within a minimum of 15 feet downstream of the terminal boxes (VAV, Dual Duct, CAV or Fan Powered).
  - 2. Thickness:
    - a. Liner thickness shall be a minimum of 1-inch, unless otherwise noted.
    - b. For indoor ductwork with internal liner, if the contractor intends eliminate external duct insulation, then the then contractor must increase internal liner thickness as needed to achieve the minimum R-values indicated in Division 23 Section "Duct Insulation"
    - c. For outdoor ductwork with internal liner, do not eliminate any external insulation. Provide the full thickness of external insulation at indicated in Division 23 Section "Duct Insulation".
- I. Double-Wall Duct Interstitial Insulation:
  - 1. Thickness:
    - a. Liner thickness shall be a minimum of 1-inch, unless otherwise noted.
    - b. For indoor ductwork with internal liner, if the contractor intends eliminate external duct insulation, then the then contractor must increase internal liner thickness as needed to achieve the minimum R-values indicated in Division 23 Section "Duct Insulation"
    - c. For outdoor ductwork with internal liner, do not eliminate any external insulation. Provide the full thickness of external insulation at indicated in Division 23 Section "Duct Insulation".
- J. Elbow Configuration:
  - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
    - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio. If radius elbows of less than 1.5 radius-to-diameter ratio are used due to space restrictions, provide turning vanes.
    - b. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
    - c. No other elbow types shall be used unless specifically noted on the drawings.
  - 2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
    - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
      - 1) 1.5 radius-to-diameter ratio and five segments for 90-degree elbow. If radius elbows of less than 1.5 radius-to-diameter ratio are used due to space restrictions, provide turning vanes.
      - 2) No other elbow types shall be used unless specifically noted on the drawings.
    - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
    - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.
- K. Branch Configuration:
  - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
    - a. Rectangular Main to Rectangular Branch: 45-degree entry.

- b. Rectangular Main to Round Branch: 45-degree entry. Bellmouth spin in allowed only for branch ducts to individual diffusers or registers.
  - c. No other branch connections shall be used unless specifically noted on the drawings.
- 2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
  - a. Velocity 1000 to 1500 fpm: Conical tap.
  - b. Velocity 1500 fpm or Higher: 45-degree lateral. Bellmouth spin in allowed only for branch ducts to individual diffusers or registers.
  - c. No other branch connections shall be used unless specifically noted on the drawings.

**END OF SECTION 233113**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Backdraft and pressure relief dampers.
  - 2. Manual volume dampers.
  - 3. Control dampers.
  - 4. Fire dampers.
  - 5. Combination fire and smoke dampers.
  - 6. Flange connectors.
  - 7. Turning vanes.
  - 8. Remote damper operators.
  - 9. Duct-mounted access doors.
  - 10. Flexible connectors.
  - 11. Flexible ducts.
  - 12. Duct accessory hardware.
- B. Related Requirements:
  - 1. Division 23 Section "Mechanical Metal Ducts".
  - 2. Division 28 Section "Digital, Addressable Fire-Alarm System" for duct-mounted fire and smoke detectors.
  - 3. Division 23 Section "General Mechanical Requirements".

**1.3 ACTION SUBMITTALS**

- A. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
  - 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
    - a. Special fittings.
    - b. Manual volume damper installations.
    - c. Control-damper installations.
    - d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
    - e. Wiring Diagrams: For power, signal, and control wiring.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.
- B. Source quality-control reports.

**1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

**1.6 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

**PART 2 - PRODUCTS**

**2.1 ASSEMBLY DESCRIPTION**

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

**2.2 MATERIALS**

- A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
  - 1. Galvanized Coating Designation: G60.
  - 2. Exposed-Surface Finish: Mill phosphatized.
- B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and No. 2B, No. 2D, No. 3, or No. 4 finish for exposed ducts.
- C. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

**2.3 BACKDRAFT AND PRESSURE RELIEF DAMPERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ruskin Company (Model CBD2).
  - 2. Greenheck Fan Corporation.
  - 3. Nailor Industries Inc.
  - 4. Pottorff.
- B. Description: Gravity balanced.
- C. Maximum Air Velocity: 2000 fpm.
- D. Maximum System Pressure: Match SMACNA pressure classification for duct system where installed. Refer to Division 23 Section "Metal Ducts".
- E. Frame: Hat-shaped, 0.090-inch- thick extruded aluminum, with welded corners or mechanically attached and mounting flange.

- F. Blades: Multiple single-piece blades, end pivoted, maximum 6-inch width, 0.025-inch- thick, roll-formed 6063-T5 formed aluminum with sealed edges.
- G. Blade Action: Parallel.
- H. Blade Seals: Extruded vinyl, mechanically locked.
- I. Blade Axles:
  - 1. Material: Corrosion-resistant, long-life, synthetic, locked to blade and formed as single piece with bearings.
- J. Tie Bars and Brackets: Aluminum.
- K. Return Spring: Adjustable tension.
- L. Bearings: Corrosion-resistant, long-life, synthetic, formed as single piece with axles].
- M. Mounting: Vertical, Horizontal - air flow up, or Horizontal - air flow down as shown on drawings.
- N. Accessories:
  - 1. Adjustment device to permit setting for varying differential static pressure.
  - 2. Counterweights and spring-assist kits for vertical airflow installations.
    - a. Adjustable zinc plated steel weights mechanically attached to blade enabling damper to operate over wide range of pressures.
  - 3. Electric actuators.
  - 4. Chain pulls.
  - 5. Screen Mounting: Front mounted in sleeve.
    - a. Sleeve Thickness: 20 gage minimum.
    - b. Sleeve Length: 12 inches minimum.
  - 6. Screen Mounting: Front or Rear mounted.
  - 7. Screen Material: Aluminum.
  - 8. Screen Type: Bird.
  - 9. 90-degree stops.

## 2.4 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Ruskin Company (MD).
    - b. McGill AirFlow LLC.
    - c. Nailor Industries Inc.
    - d. Pottorff.
    - e. Vent Products Company, Inc.
  - 2. Performance Data:
    - a. Capacity: Demonstrate capacity of damper to withstand HVAC system operating conditions.
      - 1) Closed Position: Maximum pressure of 3 inches w.g.
      - 2) Open Position: Maximum air velocity of 1,500 feet per minute (457 m/min).
    - b. Pressure Drop: Maximum 0.1 inch w.g. at 1,500 feet per minute across 24 inch x 24 inch damper.
  - 3. Standard leakage rating.
  - 4. Suitable for horizontal or vertical applications.
  - 5. Frames:
    - a. Frame: Hat-shaped, five (5) inches, minimum 16 ga. Roll formed, galvanized steel hat-shaped channel, reinforced at corners..

- b. Mitered and welded corners.
    - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
  - 6. Blades:
    - a. Multiple or single blade.
    - b. Opposed-blade design.
    - c. Single skin with 3 longitudinal grooves.
    - d. Minimum 16 ga. Equivalent thickness, galvanized steel.
    - e. Nominal 6-inch width.
  - 7. Blade Axles: Minimum ½ inch diameter, plated steel, hex shaped, mechanically attached to blade.
  - 8. Bearings:
    - a. Molded synthetic sleeve, turning in extruded hole in frame].
    - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
  - 9. Tie Bars and Brackets: Galvanized steel.
  - 10. Factory Sleeve: Minimum 20 ga. Thickness, minimum 12-inches in length.
  - 11. Actuator: Hand quadrant for 3/8 inch square extended shaft
  - 12. Hand Quadrant Standoff Bracket: 2-inch standoff for insulated ductwork.
- B. Standard, Aluminum, Manual Volume Dampers:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Ruskin Company.
    - b. McGill AirFlow LLC.
    - c. Nailor Industries Inc.
    - d. Pottorff.
    - e. Ruskin Company.
  - 2. Standard leakage rating.
  - 3. Performance Data:
    - a. Pressure Drop: Maximum 0.07 inch w.g. at 1,500 feet per minute across 24 inch x 24 inch damper.
    - b. Temperature Rating: Withstand -50 to 250 degrees F .
    - c. Capacity: Demonstrate capacity of damper to withstand HVAC system operating conditions.
      - 1) Closed Position: Maximum pressure of 3 inches w.g..
      - 2) Open Position: Maximum air velocity of 1,500 feet per minute.
  - 4. Suitable for horizontal or vertical (with thrust washers) applications.
  - 5. Frames: 5-inches x 1inch x minimum 0.125 inch 6063-T5 extruded aluminum hat shaped channel, mounting flanges on both sides of frame, reinforced at corners.
  - 6. Blades:
    - a. Multiple or single blade.
    - b. Opposed-blade design.
    - c. Stiffen damper blades for stability.
    - d. Extruded Aluminum Blades: 0.125-inch- thick.
    - e. Nominal width: 6-inches.
  - 7. Blade Axles: Minimum 1/2-inch diameter plated steel, hex shaped, mechanically attached to blade.
  - 8. Bearings:
    - a. Molded synthetic, turning in hole in frame.
    - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

9. Tie Bars and Brackets: Aluminum.

C. Low-Leakage, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Ruskin Company.
  - b. McGill AirFlow LLC.
  - c. Nailor Industries Inc.
  - d. Pottorff.
2. Performance Data:
  - a. Capacity: Demonstrate capacity of damper to withstand HVAC system operating conditions.
    - 1) Closed Position: Maximum pressure of 3 inches w.g.
    - 2) Open Position: Maximum air velocity of 1,500 feet per minute (457 m/min).
  - b. Pressure Drop: Maximum 0.1 inch w.g. at 1,500 feet per minute across 24 inch x 24 inch damper.
3. Comply with AMCA 500-D testing for damper rating.
4. Low-leakage rating and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
  - a. Leakage: Maximum 3.7 cubic feet per minute per square foot at 1 inch w.g. for all sizes 36 inches wide and above.
5. Suitable for horizontal or vertical applications.
6. Frames:
  - a. 5 inches x minimum 16 gage roll formed, galvanized steel hat-shaped channel, reinforced at corners. Structurally equivalent to 13 gage U-channel.
  - b. Mitered and welded corners.
  - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
7. Blades:
  - a. Multiple or single blade.
  - b. Orientation: Horizontal.
  - c. Material: Minimum 16 gage (1.6 mm) equivalent thickness, galvanized steel.
  - d. Width: Nominal 6 inches (152 mm)..
8. Blade Axles: Minimum 1/2 inch (13 mm) diameter plated steel, hex-shaped, mechanically attached to blade.
9. Bearings:
  - a. Molded synthetic sleeve, turning in extruded hole in frame.
  - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
10. Blade Seals: Neoprene.
11. Jamb Seals: Cambered Flexible metal compression type].
12. Accessories:
  - a. Include locking device to hold single-blade dampers in a fixed position without vibration.
  - b. Factory Sleeve: Minimum 20 gage (1.0 mm) thickness, minimum 12 inches length.

D. Low-Leakage, Aluminum, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Ruskin Company.
  - b. McGill AirFlow LLC.
  - c. Nailor Industries Inc.
  - d. Pottorff.
2. Comply with AMCA 500-D testing for damper rating.
3. Low-leakage rating, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
4. Performance Data:
  - a. Temperature Rating: Withstand -50 to 250 degrees F (-46 to 121 degrees C).
  - b. Capacity: Demonstrate capacity of damper to withstand HVAC system operating conditions.
    - 1) Closed Position: Maximum pressure of 5 inches w.g..
    - 2) Open Position: Maximum air velocity of 2,000 feet per minute.



- c. Leakage: Maximum 3.2 cubic feet per minute per square foot ( $1.0 \text{ m}^3/\text{min}/\text{m}^2$ ) at 1 inch w.g. (0.25 kPa) for all sizes 12 inches (305 mm) wide and above.
    - d. Pressure Drop: Maximum 0.07 inch w.g. (0.02 kPa) at 1,500 feet per minute (457 m/min) across 24 inch x 24 inch (610 x 610 mm) damper.
  - 5. Suitable for horizontal or vertical (with thrust washer) applications.
  - 6. Frames: 5-inches x 1-inch x 0.125 inch 6063-T5 extruded aluminum hat-shaped channel, mounting flanges on both sides of frame, reinforced at corners.
  - 7. Blades:
    - a. Multiple or single blade.
    - b. Opposed-blade design.
    - c. Minimum 0.125 inch extruded aluminum.
    - d. Width: Nominal 6-inches.
  - 8. Blade Axles: Minimum  $\frac{1}{2}$  inch diameter plated steel, hex shaped, mechanically attached to blade.
  - 9. Bearings:
    - a. Molded synthetic sleeve, turning in hole in frame.
    - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
  - 10. Blade Seals: Extruded Ruskiprene (Neoprene) edge type for low leakage. Mechanically attached to blade edge.
  - 11. Jamb Seals: Cambered Flexible metal compression type.
  - 12. Accessories:
    - a. Include locking device to hold single-blade dampers in a fixed position without vibration.
    - b. Factory Sleeve: Minimum 20 gage thickness, minimum 12 inches length.
- E. Jackshaft:
- 1. Size: 0.5-inch diameter.
  - 2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
  - 3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.
- F. Damper Hardware:
- 1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
  - 2. Include center hole to suit damper operating-rod size.
  - 3. Include elevated platform for insulated duct mounting.

## 2.5 CONTROL DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1. Cesco Products; a division of Mestek, Inc.
  - 2. Lloyd Industries, Inc.
  - 3. Metal Form Manufacturing, Inc.
  - 4. Nailor Industries Inc.
  - 5. NCA Manufacturing, Inc.
  - 6. Pottorff.
  - 7. Ruskin Company.
- B. Ratings:
- 1. Temperature Rating: -25°F to 180°F.
  - 2. Leakage:  $8.0 \text{ cfm}/\text{ft}^2$  @ 4.0 in.wg. or  $4.0 \text{ cfm}/\text{ft}^2$  @ 1.0 in.wg., with low leakage seals.
  - 3. Maximum Velocity: 3000 fpm (15.2 m/s)

4. Differential Pressure Rating: 5 in.wg. at a 12 inch blade length
- C. Low-leakage rating, with linkage concealed in frame, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
- D. Frames:
  1. Hat-shaped channel, roll formed galvanized steel with interlocking gusseted corners. Structurally equivalent to 13 gauge U-channel type frame. Low profile head and sill on sizes less than 13 inches high.
- E. Blades:
  1. 6 inch x 16 gauge (152 x 1.5 mm) maximum width.
  2. Galvanized steel 3-V.
  3. Opposed-blade design.
  4. Blade Edging: Extruded PVC blade edge.
- F. Jamb Seals: Stainless steel, flexible metal compression type
- G. Blade Axles: Minimum ½" (13mm) diameter plated steel hex-shaped, mechanically attached to blade.
- H. Bearings:
  1. Synthetic sleeve-type turning in extruded hole in frame.
  2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
  3. Thrust bearings at each end of every blade.
- I. Finish: stainless steel
- J. Accessories:
  1. Actuator:
    - a. Refer to Division 23 Section "Sequence of Operations for HVAC Controls" to determine if each motorized damper will be provided with a 2-position or modulating actuator
    - b. Refer to Division 23 Section "Sequence of Operations for HVAC Controls" to determine if each motorized damper will be fail open, closed, or in place.
    - c. Electrical voltage shall be 120 VAC. Electrical contractor will provide a junction box in the general vicinity. HVAC automatic temperature controls subcontractor shall be responsible for extending power to actuator.
    - d. Mounting shall be external.
  2. PI-50 Dual Position Indicator Switch Package: Shall connect directly to the blade axle for positive annunciation (interconnecting arms, wire-forms, or brackets shall not be accepted) and provide full open and full closed blade indication to a remote location.
  3. Flange Frame. 1 ½ inches both sides.
  4. Factory Sleeve. Minimum 20 gauge, factory installed.
  5. Duct Transition Connections: Round, Oval, or Rectangular as required.

## 2.6 FIRE DAMPERS

- A. REFERENCES
  1. AMCA 500-D – Laboratory Test Methods for Testing Dampers for Ratings.
  2. AMCA 511 - Certified Ratings Program for Air Control Devices.
  3. IBC – International Building Code.
  4. CSFM - California State Fire Marshall Listing for Fire Damper.
  5. MEA – City of New York, Department of Buildings, Material and Acceptance Division.
  6. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
  7. NFPA 101 – Life Safety Code.
  8. UL 555 - Standard for Safety; Fire Dampers
- B. QUALITY ASSURANCE
  1. Dampers shall be warranted against manufacturing defects for a period of 1 year.
  2. Dampers shall be tested, rated and labeled in accordance with the latest UL-555 requirements.

3. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
  4. Damper pressure drop ratings shall be based on tests and procedures performed in accordance with AMCA 500.
- C. Fire Rating:
1. For fire partitions rated for 2-hours or less, provide fire dampers with 1-1/2 hour rating in accordance with UL-555.
  2. For fire partitions rated for more than 2-hours, provide fire dampers with 3 hour rating in accordance with UL-555.
- D. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Pottorff.
  2. Ruskin Company.
  3. Air Balance Inc.; a division of Mestek, Inc.
  4. Arrow United Industries; a division of Mestek, Inc.
  5. Cesco Products; a division of Mestek, Inc.
  6. Greenheck Fan Corporation.
  7. Nailor Industries Inc.
  8. NCA Manufacturing, Inc.
- E. Basis of design:
1. 1½ hours in accordance with UL-555: Pottorff VFD-10-D Series (Dynamic)
  2. 3 hours in accordance with UL-555: Pottorff VFD-30-D Series (Dynamic)
- F. Type: Dynamic; rated and labeled according to UL 555 by an NRTL.
- G. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2,000 fpm velocity.
- H. Frame: Curtain type with blades outside airstream; Minimum 22 gauge roll formed, galvanized steel; with mitered and interlocking corners.
- I. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
1. Minimum Thickness: Minimum 20 gauge integral to frame, and of length to suit application.
- J. Mounting Orientation: Vertical or horizontal as indicated.
- K. Blades: Minimum 24 gauge roll formed galvanized steel, curtain type.
- L. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- M. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.
- N. Accessories:
1. Retaining Angles:
    - a. SSPF-20, 1 ½ x ¾ inches x 20 gauge single side picture frame.
    - b. SSPF-16, 1 ½ x 1 ½ inches x 16 gauge single side picture frame.
    - c. DSPF-16, 1 ½ x 1 ½ inches x 16 gauge dual side picture frame.
    - d. SS-16, 1 ½ x 1 ½ inches x 16 gauge single side, individual.
    - e. DS-16, 1 ½ x 1 ½ inches x 16 gauge dual side, individual.

## 2.7 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Pottorff.
  2. Air Balance Inc.; a division of Mestek, Inc.
  3. Cesco Products; a division of Mestek, Inc.
  4. Greenheck Fan Corporation.
  5. Nailor Industries Inc.
  6. Ruskin Company.

B. References:

1. AMCA 500-D – Laboratory Test Methods for Testing Dampers for Ratings.
2. AMCA 511 - Certified Ratings Program for Air Control Devices.
3. IBC – International Building Code.
4. CSFM - California State Fire Marshall Listing for Fire Damper and Smoke Damper.
5. MEA – City of New York, Department of Buildings, Material and Acceptance Division.
6. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
7. NFPA 92A - Smoke-Control Systems.
8. NFPA 92B – Smoke Control Systems in Atria, Covered Malls, and Large Areas.
9. NFPA 101 – Life Safety Code.
10. UL 555 - Standard for Safety; Fire Dampers.
11. UL 555S - Standard for Safety; Leakage Rated Dampers for Use in Smoke Control Systems.

B. Model: FSD-140 series combination fire smoke damper.

C. Rating:

1. Fire Rating:
  - a. For fire partitions rated for 2-hours or less, provide fire dampers with 1-1/2 hour rating in accordance with UL-555.
  - b. For fire partitions rated for more than 2-hours, provide fire dampers with 3 hour rating in accordance with UL-555.
2. Smoke Rating:
  - a. 1½ Hour Fire Rated
    - 1) FSD-141 – Leakage Class-1 - 8 cfm/ft<sup>2</sup> at 4 in.wg.
    - 2) FSD-142 – Leakage Class-2 - 20 cfm/ft<sup>2</sup> at 4 in.wg.
    - 3) FSD-143 – Leakage Class-3 - 80 cfm/ft<sup>2</sup> at 4 in.wg.
    - 4) Elevated Temperature Rating: 350°F
  - b. 3 Hour Fire Rated
    - 1) FSD-341 – Leakage Class-1 - 8 cfm/ft<sup>2</sup> at 4 in.wg.
    - 2) FSD-342 – Leakage Class-2 - 20 cfm/ft<sup>2</sup> at 4 in.wg.
    - 3) FSD-343 – Leakage Class-3 - 80 cfm/ft<sup>2</sup> at 4 in.wg.
    - 4) Elevated Temperature Rating: 350°F
  - c. Air Flow Rating: 2000 fpm
  - d. Differential Pressure Rating: 4 in.wg.

D. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.

E. Frame: Hat-shaped channel, roll formed galvanized steel with interlocking gusseted corners. Structurally equivalent to 10 gauge U-channel type frame. Low profile head and sill on sizes less than 17 inches high.

F. Blades: 6 inch maximum width x 16 gauge, 3-V shape, roll formed galvanized steel.

G. Jamb Seals: Stainless steel, flexible metal compression type.

H. Blade Seals: Silicone rubber permanently bonded to blade.

I. Axels: Minimum ½" diameter plated steel hex-shaped, mechanically attached to blade.

J. Bearings: Self-lubricating stainless steel, sleeve-type turning in extruded hole in frame.

K. Linkage: Concealed in frame.

L. Fire Closure Device: Resettable

M. Release Temperature:

1. 165 °F (74 °C).

- N. Smoke Detector: Integral, factory wired for single-point connection.
- O. Mounting: Vertical and/or Horizontal (1 ½ hour rated only)
- P. Sleeve: Standard 16 inches long x 20 gauge (406mm x 1.0mm), factory installed.
- Q. Actuator:
1. Type:
    - a. Electric 120 V, 60 Hz, two-position, fail close.
    - b. Electric 24V, 60 Hz, two-position, fail close.
    - c. Coordinate all voltage with the Fire Alarm contractor prior to submittal and ordering.
  2. Mounting:
    - a. External.
- R. Damper Motors: two-position action.
- S. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
  2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 230900 "Instrumentation and Control for HVAC."
  3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
  4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
  5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
  6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
  7. Electrical Connection: 115 V, single phase, 60 Hz.
- T. Retaining Angles:
1. Model:
    - a. SSPF-20, 1 ½ x ¾ inches x 20 gauge single side picture frame
    - b. SSPF-16, 1 ½ x 1 ½ inches x 16 gauge single side picture frame
    - c. DSPF-16, 1 ½ x 1 ½ inches x 16 gauge dual side picture frame
    - d. SS-16, 1 ½ x 1 ½ inches x 16 gauge single side, individual
    - e. DS-16, 1 ½ x 1 ½ inches x 16 gauge dual side, individual
- U. Auxiliary switches: for position indication.
1. RRL/OCI: Shall connect directly to the blade axel for positive annunciation (interconnecting arms, wire-forms, or brackets shall not be accepted) and provide full open and full closed blade indication to a remote location.
- V. Duct Smoke Detector:
1. Detectors shall be field supplied, mounted, and wired by the Fire Alarm Contractor.
  2. Sampling tubes shall be field installed in ductwork by the HVAC Contractor.

## 2.8 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ductmate Industries, Inc.
  2. Nexus PDQ; Division of Shilco Holdings Inc.
  3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

- B. Description: roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

## **2.9 TURNING VANES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ductmate Industries, Inc.
  - 2. Duro Dyne Inc.
  - 3. METALAIRE, Inc.
  - 4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
  - 1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."
- E. Vane Construction: Double wall.

## **2.10 REMOTE DAMPER OPERATORS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Young Regulator Company.
  - 2. Pottorff.
  - 3. Ventfabrics, Inc.
- B. Description: Cable system designed for remote manual damper adjustment.
- C. Tubing: Galvanized Steel.
- D. Cable: Stainless steel.
- E. Wall-Box Mounting: Recessed.
- F. Wall-Box Cover-Plate Material: Stainless steel.

## **2.11 DUCT-MOUNTED ACCESS DOORS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cesco Products; a division of Mestek, Inc.
  - 2. Ductmate Industries, Inc.
  - 3. Elgen Manufacturing.
  - 4. Greenheck Fan Corporation.
  - 5. McGill AirFlow LLC.
  - 6. Nailor Industries Inc.
  - 7. Pottorff.
  - 8. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."

1. Door:
  - a. Double wall, rectangular.
  - b. 22 gauge galvanized sheet metal with 1" thick fiberglass insulation fill and thickness as indicated for duct pressure class.
  - c. Hinges and Latches: piano hinge and cam latches see schedule below.
  - d. Fabricate doors airtight and suitable for duct pressure class.
2. Frame: 22 gauge galvanized sheet steel, with bend-over tabs and closed cell neoprene gaskets for door to frame and frame to duct.
3. Latches: Plated steel, cam type.
4. Hinge: Zinc plated steel continuous piano type.
5. Number of Hinges and Locks:
  - a. Access Doors Less Than 12 Inches Square: No hinges and two cam locks.
  - b. Access Doors up to 14 Inches Square: Continuous hinge and one cam latch.
  - c. Access Doors 16" by 16" Inches and larger: Continuous hinge and two cam latches.

## **2.12 DUCT ACCESS PANEL ASSEMBLIES**

- A. Manufacturers: Subject to compliance with requirements, [provide products by one of the following:
1. Ductmate Industries, Inc.
  2. Flame Gard, Inc.
  3. 3M.
- B. Labeled according to UL 1978 by an NRTL.
- C. Panel and Frame: Minimum thickness 0.0428-inch stainless steel.
- D. Fasteners: Stainless steel. Panel fasteners shall not penetrate duct wall.
- E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.
- F. Minimum Pressure Rating: 10-inch wg, positive or negative.

## **2.13 FLEXIBLE CONNECTORS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ductmate Industries, Inc.
  2. Duro Dyne Inc.
  3. Elgen Manufacturing.
  4. Ventfabrics, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 24 Gauge, galvanized sheet steel or 20 gauge aluminum sheets. Provide metal compatible with connected ducts.

- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
  - 1. Minimum Weight: 22 oz./sq. yd..
  - 2. Tensile Strength: 500 lbf/inch in the warp and 500 lbf/inch in the filling.
  - 3. Service Temperature: Minus 40 to plus 200 deg F.
- F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
  - 1. Minimum Weight: 24 oz./sq. yd..
  - 2. Tensile Strength: 250 lbf/inch in the warp and 275 lbf/inch in the filling.
  - 3. Service Temperature: Minus 40 to plus 250 deg F.
- G. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
  - 1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
  - 2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  - 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
  - 7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

## **2.14 DUCT ACCESSORY HARDWARE**

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft or control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts and as indicated on the drawings. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
  - 1. Install steel volume dampers in steel ducts.
  - 2. Install aluminum volume dampers in aluminum ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire and smoke dampers according to UL listing.



- H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
1. On both sides of duct coils.
  2. Upstream and downstream from duct filters.
  3. At outdoor-air intakes and mixed-air plenums.
  4. At drain pans and seals.
  5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
  6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
  7. At each change in direction and at maximum 50-foot spacing.
  8. Upstream and downstream from turning vanes.
  9. Upstream and downstream from duct silencers.
  10. Control devices requiring inspection.
- I. Install access doors with swing against duct static pressure.
- J. Access Door Sizes:
1. One-Hand or Inspection Access: 8 by 8 inches.
  2. Two-Hand Access: 12 by 12 inches.
  3. Head and Hand Access: 18 by 10 inches.
  4. Head and Shoulders Access: 21 by 14 inches.
  5. Body Access: 25 by 14 inches.
  6. Body plus Ladder Access: 25 by 17 inches.
- K. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- L. Install flexible connectors to connect ducts to equipment.
- M. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- N. Connect terminal units to supply ducts directly, except for fan-powered terminal units which shall be provided with flexible connectors.
- O. Connect diffusers to ducts with maximum 36-inch lengths of flexible duct clamped or strapped in place.
- P. Install duct test holes where required for testing and balancing purposes.
- Q. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

### 3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
1. Operate dampers to verify full range of movement.
  2. Inspect locations of access doors and verify that purpose of access door can be performed.
  3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
  4. Inspect turning vanes for proper and secure installation.
  5. Operate remote damper operators to verify full range of movement of operator and damper.

**END OF SECTION 233300**

## **PART 1 - GENERAL**

### **1.1. SUMMARY**

- A. Section Includes: HVAC Power Ventilators
- B. Related Sections:
  - 1. Division 01 General Requirements
  - 2. Division 07 Thermal and Moisture Protection
  - 3. Division 09 Finishes
  - 4. Division 23 Heating, Ventilating, and Air-Conditioning (HVAC)
  - 5. Division 26 Electrical

### **1.2. REFERENCES**

- A. Air Movement and Control Association Inc. (AMCA):
  - 1. 99 - Standards Handbook
  - 2. 200 - Publication, Air Systems
  - 3. 201-90 - Publication, Fans and Systems
  - 4. 202-88 - Publication, Troubleshooting
  - 5. 203-90 - Publication, Field Performance Measurement of Fan Systems
  - 6. 211-05 - Publication, Certified Ratings Program - Product Rating Manual for Fan Air Performance
  - 7. 300-96 - Standard Reverberant Room Method for Sound Testing of Fans
  - 8. 311-05 - Publication, Certified Ratings Program - Product Rating Manual for Fan Sound Performance
  - 9. 99-0401-86 - Classification for Spark Resistant Construction
  - 10. 99-2408-69 - Operating Limits for Centrifugal Fans
- B. Air Movement and Control Association Inc. (AMCA), American National Standards Institute (ANSI):
  - 1. 204-05 - Standards Balance Quality and Vibration Levels for Fans
  - 2. 210-99 - Standard Laboratory Methods of Testing Fans for Aerodynamic Performance Rating
- C. American National Standards Institute (ANSI):
  - 1. 11-r1999 - Method of Evaluating Load Ratings of Bearings
- D. American Society of Civil Engineers (ASCE):
  - 1. 7-02 - Minimum Design Loads for Building and Other Structures
- E. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE):
  - 1. Chapter 45 - 2003 Handbook, HVAC Applications
  - 2. Chapter 7 - 2001 Fundamentals handbook, Sound-Vibration
  - 3. Chapter 32 - 2001 Fundamentals handbook, Duct Design
  - 4. Chapter 18 - 1992 HVAC System and Equipment handbook, Fans
- F. American Society for Testing and Materials (ASTM):
  - 1. E330-02 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylight and Curtain Walls by Uniform Static Air Pressure Differences
- G. National Fire Protection Association (NFPA):
  - 1. 70 - National Electrical Code
  - 2. 90A-02 - Standard for the Installation of Air-Conditioning and Ventilating Systems
  - 3. 92A-06 - Recommend Practice for Smoke-Control System
  - 4. 92B-05 - Standard for Smoke Management System in Malls, Atria, and Large Areas
  - 5. 96-04 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations
- H. Occupational Safety and Health Administration (OSHA):

1. 1910.212 - General requirements for Machine Guarding
2. 1910.219 - General requirements for guarding safe use of mechanical power transmission apparatus
3. 1926.300 - General requirements for safe operation and maintenance of hand and power tools
- I. Underwriters Laboratories (UL):
  1. 507 - Electric Fans
  2. 555 - Fire Dampers
  3. 555S - Smoke Dampers
  4. 705 - Standard Power Ventilators
  5. 762 - Standard Power Roof Ventilators for Restaurant Exhaust Appliances
  6. 793 - Snow Load

### **1.3. SUBMITTALS**

- A. General: Submit in accordance with Division 01 Submittal Procedures
- B. Provide dimensional drawings and product data on each fan
- C. Provide fan curves for each fan at the specified operation point, with the flow, static pressure, and horsepower clearly plotted
- D. Provide outlet velocity and fan's inlet sound power readings for the eight octave bands, decibels, and sones
- E. Strictly adhere to QUALITY ASSURANCE requirements as stated in section 1.04 of this specification
- F. Provide manufacturer's certification that exhaust fans are licensed to bear Air Movement and Control Association (AMCA), Certified Rating Seal for sound and air performance
- G. Installation, Operation, and Maintenance Manual (IOM): Provide manufacturer's installation, operations, and maintenance manual, including instructions on installation, operations, maintenance, pulley adjustment, receiving, handling, storage, safety information and cleaning. A troubleshooting guide, parts list, warranty, and electrical wiring diagrams

### **1.4. QUALITY ASSURANCE**

- A. Performance ratings: Conform to AMCA standard 211 and 311. Fans must be tested in accordance with ANSI/AMCA Standard 210-99 and AMCA Standard 300-96 in an AMCA accredited laboratory. Fans shall be certified to bear the AMCA label for sound and air performance seal
- B. Classification for Spark Resistant Construction, levels A, B and C, conform to AMCA 99
- C. Each fan shall be given a balancing analysis which is applied to wheels at the outside radius. The maximum allowable static and dynamic imbalance is 0.05 ounces (Balance grade of G6.3)
- D. Comply with the National Electrical Manufacturers Association (NEMA), standards for motors and electrical accessories
- E. The High Wind models have been analyzed and stamped by a state license P.E. to the ASCE 7-02 Standard which meets the IBC, Florida and Miami-Dade codes
- F. Each High Wind model is subject to be certified by a third party to the ASTM E330 Static Pressure Difference Standard
- G. All High Wind models have been analyzed using Computational Fluid Dynamics (CFD). The CFD simulates the flow of high speed (150MPH) winds over the surface of objects
- H. The Finite Element Analysis (FEA) is the results from the CFD and it can accurately predict the stress, strain, and deflection resulting from high wind loads

### **1.5. DELIVERY, STORAGE, AND HANDLING**

- A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer, material, products included, and location of installation
- B. Storage: Store materials in a dry area indoor, protected from damage, and in accordance with manufacturer's instructions. For long term storage follow manufacturer's Installation, Operations, and Maintenance Manual
- C. Handling: Handle and lift fans in accordance with the manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage. Follow all safety warnings posted by the manufacturer

### **1.6. WARRANTY**

A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents

1. The warranty of this equipment is to be free from defects in material and workmanship for a period of 1 Yr (Standard) from the purchase date. Any units or parts which prove defective during the warranty period will be replaced at the Manufacturers option when returned to Manufacturer, transportation prepaid
2. Motor Warranty is warranted by the motor manufacturer for a period of 1 year. Should motors furnished by us prove defective during this period, they should be returned to the nearest authorized motor service station

**1.7. MAINTENANCE**

A. Refer to Manufacturer's Installation, Operation and Maintenance Manual (IOM), to find maintenance procedures

**PART 2 - PRODUCTS**

**2.1. MANUFACTURER**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Greenheck
2. Loren Cook Company
3. Penn Barry
4. Trane

**2.3. DIRECT DRIVE ROOF OR SIDEWALL UPBLAST CENTRIFUGAL EXHAUST FANS**

A. General Description:

1. Discharge air directly away from the mounting surface.
2. Upblast fan shall be for roof mounted applications for fan sizes 060-300 or wall mounted applications for fan sizes 060-200.
3. Performance capabilities up to 14,700 cubic feet per minute (cfm) and static pressure to 3 inches of water gauge.
4. Fans are available in twenty-two sizes with nominal wheel diameters ranging from 9 inches through 30 inches (060 - 300 unit sizes).
5. Maximum continuous operating temperature for fan sizes 098-300 is 400 Fahrenheit (204.4 Celsius) and for fan sizes 060-095 is 160 Fahrenheit ( 71.1 Celsius)
6. Each fan shall bear a permanently affixed manufacture's engraved metal nameplate containing the model number and individual serial number

B. Wheel:

1. Material Type: Aluminum
2. Non-overloading, backward inclined centrifugal wheel
3. Statically and dynamically balanced in accordance to AMCA Standard 204-05
4. The wheel cone and fan inlet will be matched and shall have precise running tolerances for maximum performance and operating efficiency

C. Motors:

1. Electronically Commutated Motor
  - a. Motor enclosure: Open drip proof
  - b. Motor to be a DC electronic commutation type motor (ECM) specifically designed for fan applications. AC induction type motors are not acceptable. Examples of unacceptable motors are: Shaded Pole, Permanent Split Capacitor (PSC), Split Phase, Capacitor Start and 3 phase induction type motors

- c. Motors are permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the specific voltage and phase
  - d. Internal motor circuitry to convert AC power supplied to the fan to DC power to operate the motor
  - e. Motor shall be speed controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal
  - f. Motor shall be a minimum of 85% efficient at all speeds
- D. Housing:
  - 1. Constructed of heavy gauge aluminum includes exterior housing, curb cap, windband, and motor compartment housing. Galvanized material is not acceptable
  - 2. Housing shall have a rigid internal support structure
  - 3. Windband to be one piece uniquely spun aluminum construction and maintain original material thickness throughout the housing
  - 4. Windband to include an integral rolled bead for strength
  - 5. Curb cap base to be fully welded to windband to ensure a leak proof construction. Tack welding, bolting, and caulking are not acceptable
  - 6. Curb cap to have integral deep spun inlet venturi and pre-punched mounting holes to ensure correct attachment to curb
  - 7. Drive frame assemblies shall be constructed of heavy gauge steel and mounted on vibration isolators
  - 8. Breather tube shall be 10 square inches in size for fresh air motor cooling, and designed to allow wiring to be run through it
- E. Motor Cover:
  - 1. Constructed of aluminum
- F. Vibration Isolation:
  - 1. Double studded or pedestal style true isolators
  - 2. No metal to metal contact
  - 3. Sized to match the weight of each fan
- G. Disconnect Switches:
  - 1. NEMA rated: NEMA 4X: outdoor application. Factory standard.
  - 2. Positive electrical shut-off
  - 3. Wired from fan motor to junction box installed within motor compartment
- H. Drain Trough:
  - 1. Allows for one-point drainage of water, grease, and other residues
- I. Options/Accessories:
  - 1. Roof Curbs:
    - 1. Type: GPI Welded, straight sided curb with 2 inches of flashing flange and wood nailer
    - 2. Mounted onto roof with fan
    - 3. Material: Galvanized
    - 4. Insulation thickness: 1 inch
  - 2. Dampers:
    - a. Type: VCD-23, 115 VAC
    - b. Prevents outside air from entering back into the building when fan is off
    - c. Balanced for minimal resistance to flow
    - d. Galvanized frames with prepunched mounting holes
  - 3. Curb Seal:

- a. Foam Seal - dense foam tape seal

### **3. EXECUTION**

#### **3.1. MANUFACTURER'S INSTRUCTIONS**

- A. Compliance: Comply with manufacturer's product data, including technical bulletins, product catalog installation instructions

#### **3.2. EXAMINATION**

- A. Examine areas to receive fans. Notify the Engineer of conditions that would adversely affect installation or subsequent utilization and maintenance of fans. Do not proceed with installation until unsatisfactory conditions are corrected

#### **3.3. PREPARATION**

- A. Ensure roof openings are square, accurately aligned, correctly located, and in tolerance
- B. Ensure duct is plumb, sized correctly, and to proper elevation above roof deck. Install duct as specified in Air Distribution (Division 23)

#### **3.4. INSTALLATION**

- A. Install fans system as indicated on the Installation, Operation and Maintenance Manual (IOM) and contract drawings
- B. Install fans in accordance with manufacturer's instructions

#### **3.5. SYSTEM STARTUP**

- A. Refer to Installation, Operation, and Maintenance Manual (IOM)

#### **3.6. ADJUSTING**

- A. Adjust exhaust fans to function properly
- B. Lubricate bearings
- C. Adjust for final system balancing
- D. Check wheel overlap

#### **3.7. CLEANING**

- A. Clean as recommended by manufacturer. Do not use material or methods which may damage finish surface or surrounding construction

#### **3.8. PROTECTION**

- A. Protect installed product and finished surfaces from damage during construction
- B. Protect installed exhaust fans to ensure that, except for normal weathering, fans will be without damage or deterioration at time of substantial completion

**END OF SECTION 233423**

## **PART 1 - GENERAL**

### **1.1 RELATED DOCUMENTS**

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

### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Square ceiling diffusers.
  - 2. Linear slot diffusers.
  - 3. Fixed face registers.
  - 4. Adjustable face registers.
  - 5. Fixed face grilles.
- B. Related Sections:
  - 1. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated, include the following:
  - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
  - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
  - 3. Color chart for Architect and Engineer review.

### **1.4 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
  - 1. Ceiling suspension assembly members.
  - 2. Method of attaching hangers to building structure.
  - 3. Size and location of initial access modules for acoustical tile.
  - 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
  - 5. Duct access panels.
- B. Source quality-control reports.

## **PART 2 - PRODUCTS**

### **2.1 CEILING DIFFUSERS**

- A. Square Ceiling Diffusers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Titus.
    - b. Price Industries.
    - c. Anemostat Products; a Mestek company.
    - d. Kreuger.
  - 2. Devices shall be specifically designed for variable-air-volume flows.



3. Material: Refer to schedule on drawings.
4. Finish: Refer to schedule on drawings.
5. Face Size: Refer to schedule on drawings.
6. Face Style: Refer to schedule on drawings.
7. Mounting: Refer to schedule on drawings.
8. Pattern: Refer to schedule on drawings.
9. Dampers: Refer to schedule on drawings.
10. Accessories: Refer to schedule on drawings.

## **2.2 LINEAR DIFFUSERS**

- A. Linear Slot Diffuser:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Titus.
    - b. Price Industries.
    - c. Anemostat Products; a Mestek company.
    - d. Kreuger.
  2. Devices shall be specifically designed for variable-air-volume flows.
  3. Material - Shell: Refer to schedule on drawings.
  4. Material - Pattern Controller and Tees: Refer to schedule on drawings.
  5. Finish - Face and Shell: Refer to schedule on drawings.
  6. Finish - Pattern Controller: Refer to schedule on drawings.
  7. Finish - Tees: Refer to schedule on drawings.
  8. Slot Width: Refer to schedule on drawings.
  9. Number of Slots: Refer to schedule on drawings.
  10. Length: Refer to schedule on drawings.

## **2.3 REGISTERS AND GRILLES**

- A. Fixed Face Register:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Titus.
    - b. Price Industries.
    - c. Anemostat Products; a Mestek company.
    - d. Kreuger.
  2. Material: Refer to schedule on drawings.
  3. Finish: Refer to schedule on drawings.
  4. Face Arrangement: Refer to schedule on drawings. Blades shall be horizontal for sidewall applications. Blades shall be parallel to the long dimension for ceiling applications.
  5. Core Construction: Refer to schedule on drawings.
  6. Frame: Refer to schedule on drawings.
  7. Mounting: Refer to schedule on drawings.
  8. Damper Type: Refer to schedule on drawings.
- B. Adjustable Face Register:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Titus.
    - b. Price Industries.
    - c. Anemostat Products; a Mestek company.
    - d. Kreuger.
  2. Material: Refer to schedule on drawings.
  3. Finish: Refer to schedule on drawings.
  4. Face Arrangement: Refer to schedule on drawings. Outer set of blades shall be horizontal for sidewall applications. Outer set of blades shall be parallel to the long dimension for ceiling applications.
  5. Core Construction: Refer to schedule on drawings.
  6. Frame: Refer to schedule on drawings.
  7. Mounting: Refer to schedule on drawings.
  8. Damper Type: Refer to schedule on drawings.

C. Fixed Face Grille:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Titus.
  - b. Price Industries.
  - c. Anemostat Products; a Mestek company.
  - d. Kreuger.
2. Material: Refer to schedule on drawings.
3. Finish: Refer to schedule on drawings.
4. Face Arrangement: Refer to schedule on drawings. Blades shall be horizontal for sidewall applications. Blades shall be parallel to the long dimension for ceiling applications.
5. Core Construction: Refer to schedule on drawings.
6. Frame: Refer to schedule on drawings.
7. Mounting: Refer to schedule on drawings.
8. Damper Type: Refer to schedule on drawings.

**2.4 SOURCE QUALITY CONTROL**

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 INSTALLATION**

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

**3.3 ADJUSTING**

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

**END OF SECTION 233713**

## SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes split-system air-conditioning consisting of separate evaporator-fan and outdoor compressor-condenser components.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

2. Wiring Diagrams: For power, signal, and control wiring.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Warranty: Sample of special warranty.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

#### 1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance:
  1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

#### 1.7 COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period:
    - a. For Compressor: Five (5) years from date of Substantial Completion.
    - b. For Parts: Five (5) years from date of Substantial Completion.
    - c. For Labor: One (1) year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - 1. Mitsubishi Electric & Electronics USA, Inc. (basis of design)
  - 2. Daikin North America

2.2 INDOOR UNITS (5 TONS OR LESS)

- A. Wall-Mounted, Evaporator-Fan Components:
  - A. GENERAL:
    - 1. Refer to drawings for equipment schedules. Mitsubishi is basis of design.
    - 2. Service valves shall be installed in supply and return refrigerant piping near each unit and shall be accessible through access doors. Purpose of service valves is to close off refrigerant flow to each individual unit for servicing or replacement without an entire system shutdown.

3. Indoor unit is to be from the same manufacturer as the outdoor unit.
4. Indoor unit is to be fully compatible with the outdoor unit as documented by the manufacturer.
5. Dual set point functionality.
6. Compact floor mount.
7. Two-speed settings.
8. Controls to be unit-mounted in a hidden case.
9. IT Terminal Plug.

## 2.3 OUTDOOR UNITS (5 TONS OR LESS)

### B. GENERAL:

1. The condensing unit is designed specifically for use with VRV series components.
2. The condensing unit shall be factory assembled in the USA and pre-wired with all necessary electronic and refrigerant controls.
3. The refrigeration circuit of the condensing unit shall consist of an inverter scroll compressors, motors, fans, condenser coil, electronic expansion valves, solenoid valves, filters, shut off valves, oil separators, service ports and refrigerant accumulator.
4. Liquid and suction lines must be individually insulated between the condensing and indoor units.
5. The condensing unit can be wired and piped with access from the left, right, rear or bottom.
6. The system will automatically restart operation after a power failure and will not cause any settings to be lost, thus eliminating the need for reprogramming.
7. The unit shall incorporate an auto-charging feature to ensure optimum performance. Manual changing should be support with a minimum of 2 hours of system operation data to ensure correct operation.
8. The following safety devices shall be included on the condensing unit; high pressure sensor and switch, low pressure switch, control circuit fuses, crankcase heaters, fusible plug, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter and anti-recycling timers.
9. To ensure the liquid refrigerant does not flash when supplying to the various indoor units, the circuit shall be provided with a sub-cooling feature.
10. Oil recovery cycle shall be automatic occurring 2 hours after start of operation and then every 8 hours of operation.
11. The condensing unit shall be capable of heating operation at 0°F (-18°C) dry bulb ambient temperature without additional low ambient controls or an auxiliary heat source.

### C. UNIT CABINET:

1. The condensing unit shall be completely weatherproof and corrosion resistant. The unit shall be constructed from rust-proofed galvanized steel panels coated with a baked enamel finish.

D. FAN:

1. The condensing unit shall consist of one or more propeller type, direct-drive fan motors that have multiple speed operation via a DC (digitally commutating) inverter.
2. The condensing unit fan motor shall have multiple speed operation of the DC (digitally commutating) inverter type, and be of high external static pressure and shall be factory set as standard at 0.12 in. WG. A field setting switch to a maximum 0.32 in. WG pressure is available to accommodate field applied duct for indoor mounting of condensing units.
3. The fan shall be a vertical discharge configuration.
4. The fan motor shall have inherent protection and permanently lubricated bearings and be mounted.
5. The fan motor shall be provided with a fan guard to prevent contact with moving parts.

E. CONDENSER COIL:

1. The condenser coil shall be manufactured from copper tubes expanded into aluminum fins to form a mechanical bond.
2. The heat exchanger coil shall be of a waffle louver fin and rifled bore tube design to ensure high efficiency performance.
3. The heat exchanger on the condensing units shall be manufactured from seamless copper tube with N-shape internal grooves mechanically bonded on to aluminum fins.
4. The fins shall be coated with an anti-corrosion hydrophilic blue coating as standard from factory with a salt spray test rating of 1000hr per ASTM test standards.
5. The outdoor coil shall have three-circuit heat exchanger design eliminating the need for a drain pan heater. The lower part of the coil shall be used for inverter cooling and be on or off during heating operation enhancing the defrost operation.
  - a. An alternate manufacturer must provide a drain pan heater to enable adequate defrosting of the unit in defrost operation.
6. The condensing unit shall be factory equipped with condenser coil guards on all sides.

F. COMPRESSOR:

1. The inverter scroll compressors shall be variable speed (PVM inverter) controlled which is capable of changing the speed to follow the variations in total cooling and heating load as determined by the suction gas pressure as measured in the condensing unit.
  - a. In addition, samplings of evaporator and condenser temperatures shall be made so that the high/low pressures detected are read every 20 seconds and calculated. With each reading, the compressor capacity (INV frequency) shall be controlled to eliminate deviation from target value.
    - 1) Non –inverter-driven compressors, which may cause starting motor current to exceed the nominal motor current (RLA) and require larger wire sizing, shall not be allowed.

2. The inverter driven compressors in the condensing unit shall be of highly efficient reluctance DC (digitally commutating), hermetically sealed scroll "G-type" or "J-type".
3. Neodymium magnets shall be adopted in the rotor construction to yield a higher torque and efficiency in the compressor instead of the normal ferrite magnet type.
  - a. At complete stop of the compressor, the neodymium magnets will position the rotor into the optimum position for a low torque start.
4. The capacity control range shall be as low as 10% to 100%.
5. The compressor's motor shall have a cooling system using discharge gas, to avoid sudden changes in temperature resulting in significant stresses on winding and bearings.
6. Each compressor shall be equipped with a crankcase heater, high pressure safety switch, and internal thermal overload protector.
7. Oil separators shall be standard with the equipment together with an intelligent oil management system.
8. The compressor shall be mounted on vibration dampening rubber grommets to minimize the transmission of vibration, eliminating the standard need for external spring isolation.
9. In the event of compressor failure, the remaining compressors shall continue to operate and provide heating or cooling as required at a proportionally reduced capacity. The microprocessor and associated controls shall be manually activated to specifically address this condition for single module and manifolded systems.
10. In the case of multiple condenser modules, conjoined operation hours of the compressors shall be balanced by means of a Duty Cycling Function, ensuring sequential starting of each module at each start/stop cycle, completion of oil return, completion of defrost or every 8 hours. When connected to a central control system sequential start is activated for all system on each DIII network.
11. Refrigerant Charge: R-410A.

## 2.4 ACCESSORIES

- A. Control equipment and sequence of operation are specified in Section 230900 "Instrumentation and Control for HVAC" and Section 230993 "Sequence and Operations for HVAC Controls."
- B. Thermostat: Low voltage with subbase to control compressor and evaporator fan.
- C. Automatic-reset timer to prevent rapid cycling of compressor.
- D. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
- E. Drain Hose: For condensate.

## 2.5 CAPACITIES AND CHARACTERISTICS

- A. Refer to equipment schedules on the drawings.



### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install roof-mounted, compressor-condenser components on equipment supports specified in Section 077200 "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.
- D. Equipment Mounting:
  - 1. Comply with requirements for vibration isolation devices specified in Section "Vibration Controls for HVAC."
- E. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

#### 3.2 CONNECTIONS

- A. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

### 3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

### 3.4 STARTUP SERVICE

- A. Perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.

### 3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 238126

**PART 1 - GENERAL**

**1.01 SUBMITTALS**

- A. Product Data: Literature shall be provided that indicates dimensions, operating and shipping weights, capacities, ratings, fan performance, filter information, factory supplied accessories, electrical characteristics, and connection requirements. Installation, Operation, and Maintenance manual with startup requirements shall be provided.
- B. Shop Drawings: Unit drawings shall be provided that indicate assembly, unit dimensions, construction details, clearances, and connection details. Computer generated fan curves for each fan shall be submitted with specific design operation point noted. Wiring diagram shall be provided with details for both power and control systems and differentiate between factory installed and field installed wiring.

**1.02 QUALITY ASSURANCE**

- A. MANUFACTURER QUALIFICATIONS:
  - 1. The units shall be tested by a National Recognized Testing Laboratory (NRTL), in accordance with ANSI/UL 1995 – Heating and Cooling Equipment and bear the Listed Mark.
  - 2. All wiring shall be in accordance with the National Electric Code (NEC).
  - 3. The system will be produced in an ISO 9001 and ISO 14001 facility, which are standards set by the International Standard Organization (ISO). The system shall be factory tested for safety and function.
  - 4. The condensing unit will be factory charged with R410A.

**1.03 DELIVERY, STORAGE AND HANDLING**

- A. Unit shall be stored and handled according to the manufacturer's recommendations.

**1.04 WARRANTY**

- A. STANDARD LIMITED WARRANTY
  - 1. The manufacturer shall warrant that the equipment will be free from defects in material and workmanship. This warranty applies to compressor and all parts and is limited in duration to ten (10) years starting from the "installation date" which is one of the two dates below:
    - a. The installation date is the date that the unit is originally commissioned, but no later than 18 months after the manufacture date noted on the unit's rating plate.
    - b. If the date the unit is originally commissioned cannot be verified, the installation date is three months after the manufacture date.

**PART 2 - PRODUCTS**

**2.01 MANUFACTURERS**

- A. Subject to compliance with requirements, provide products by one of the following:

1. Mitsubishi (Basis of Design)
  2. Daikin
- B. For manufacturers which are not the "Basis of Design", refer to Division 01 "Product Substitution Procedures" for additional submittal and coordination requirements.

## **2.02 HVAC SYSTEM DESIGN**

### **A. SYSTEM DESCRIPTION:**

1. Variable capacity heat pump air conditioning system.
2. The system shall consist of multiple evaporators using PID control, joints and headers, a two-pipe refrigeration distribution system and condenser unit.
3. The condenser shall be a direct expansion (DX), air-cooled heat pump, multi-zone air-conditioning system with variable speed inverter driven compressors using R-410A refrigerant.
4. The condensing unit may connect an indoor evaporator capacity up to 200% of the condensing unit capacity. All zones are each capable of operating separately with individual temperature control.
5. The condensing unit shall be interconnected to indoor unit models.
  - a. The indoor units shall be connected to the condensing unit utilizing VRF equipment manufacturer's specified piping joints and headers to ensure correct refrigerant flow and balancing. T style joints are not acceptable for a variable refrigerant system.
6. Operation of the system shall permit either cooling or heating of all of the indoor units simultaneously. Each indoor unit or group of indoor units shall be able to provide set temperature independently via a local remote controller, an Intelligent Manager, an Intelligent Controller or a BMS interface.

### **B. FEATURES**

1. Voltage Platform - Heat pump condensing units shall be available with a 208-230V/3ph/60Hz power supply.
2. Advanced Zoning - A single system shall provide for up to 64 zones.
3. Independent Control - Each indoor unit shall use a dedicated electronic expansion valve with 2000 positions for independent control.
4. VFD Inverter Control and Variable Refrigerant Temperature - Each condensing unit shall use high efficiency, variable speed all "inverter" compressor(s) coupled with inverter fan motors to optimize part load performance. The system capacity and refrigerant temperatures shall be modulated automatically to set suction and condensing pressures while varying the refrigerant volume for the needs of the cooling or heating loads. The control will be automatic and customizable depending on load and weather conditions.
  - a. Indoor shall use PID to control superheat to deliver a comfortable room temperature condition and optimize efficiency.
5. Configurator software - Each system shall be available with configurator software package to allow for remote configuration of operational settings and also for assessment of operational data and error codes.
  - a. If this software is not provided by an alternate manufacturer, for each individual outdoor unit the contractor shall do the settings manually and keep detailed records for future maintenance purposes.
6. Autocharging - Each system shall have a refrigerant auto-charging function.

7. Flexible Design –
  - a. Systems shall be capable of up to 540ft (165m) actual or 623 ft. (190m) equivalent of linear piping between the condensing unit and furthest located indoor unit.
  - b. Systems shall be capable of up to 3,280ft (1,000m) total “one-way” piping in the piping network.
  - c. Systems shall have a vertical (height) separation of up to 295ft between the condensing unit and the indoor units.
  - d. Systems shall be capable of up to 295ft (90m) from the first REFNET™ / branch point.
  - e. The condensing unit shall have the ability to connect an indoor unit evaporator capacity of up to 200% of the condensing unit nominal capacity.
  - f. Systems shall be capable of 98ft (30m) vertical separation between indoor units.
  - g. Condensing units shall be supported with a fan motor ESP up to 0.32” WG as standard to allow connection of discharge ductwork and to prevent discharge air short circuiting.
8. Oil Return – Each system shall be furnished with a centrifugal oil separator and active oil recovery cycle.
9. Simple wiring – Systems shall use 16/18 AWG, 2 wire, stranded, non-shielded and non-polarized daisy chain control wiring.
10. Space saving – Each system shall have a condensing unit module footprint no larger than 48-7/8” x 30-3/16” (1694mm x 1242mm x 767mm).
11. Advanced diagnostics – Systems shall include a self-diagnostic, auto-check function to detect a malfunction and display the type and location.
12. Each condensing unit shall incorporate contacts for electrical demand shedding with optional 3 stage demand control with 12 customizable demand settings.
13. Advanced controls – Each system shall have at least one remote controller capable of controlling up to 16 indoor units.
14. Each system shall be capable of integrating with open protocol BACnet and LonWorks building management systems.
15. Low sound levels - Each system shall use indoor and condensing units with quiet operation as low as 27 dB(A).
16. Cooling Operation:
  - a. The operating range in cooling will be 23°F DB ~ 122°F DB (-5°CDB ~ 50°CDB).
  - b. Cooling mode indoor room temperature range will be 57-77°F WB (13.8 - 25°CWB).
17. Heating Operation:
  - a. The operating range in heating will be -4°F WB – 60°F WB (-20°CWB – 15.5°CWB).
  - b. Heating mode indoor room temperature range will be 59°FDB - 80°F DB (15°CDB – 26.7°CDB).

## 2.03 EQUIPMENT

### A. WIRING:

1. The control voltage between the indoor and condensing unit shall be 16VDC non-shielded, stranded 2 conductor cable.
2. The control wiring shall be a two-wire multiplex transmission system, making it possible to connect multiple indoor units to one condensing unit with one 2-cable wire, thus simplifying the wiring installation.

### B. REFRIGERANT PIPING:

1. The system shall be capable of refrigerant piping up to 540ft (165m) actual or 623ft (190m) equivalent from the condensing unit to the furthest indoor unit, a total combined liquid line length of 3,280ft (1,000m) of piping between the condensing and indoor units with 295ft (90m) maximum vertical difference, without any oil traps or additional components.
2. Manufacturer supplied piping joints and headers shall be used to ensure proper refrigerant balance and flow for optimum system capacity and performance.
  - a. T style joints shall not be acceptable as this will negatively impact proper refrigerant balance and flow for optimum system capacity and performance.

## **2.04 OUTDOOR/CONDENSING UNIT**

### **A. GENERAL:**

1. The condensing unit is designed specifically for use with VRV series components.
2. The condensing unit shall be factory assembled in the USA and pre-wired with all necessary electronic and refrigerant controls.
3. The refrigeration circuit of the condensing unit shall consist of an inverter scroll compressors, motors, fans, condenser coil, electronic expansion valves, solenoid valves, 4-way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports and refrigerant accumulator.
4. Liquid and suction lines must be individually insulated between the condensing and indoor units.
5. The condensing unit can be wired and piped with access from the left, right, rear or bottom.
6. The connection ratio of indoor units to condensing unit shall be permitted up to 200% of nominal capacity.
7. Each condensing system shall be able to support the connection of up to 64 indoor units dependent on the model of the condensing unit.
8. The system will automatically restart operation after a power failure and will not cause any settings to be lost, thus eliminating the need for reprogramming.
9. The unit shall incorporate an auto-charging feature to ensure optimum performance. Manual changing should be support with a minimum of 2 hours of system operation data to ensure correct operation.
10. The condensing unit shall be modular in design and should allow for side-by-side installation with minimum spacing.
11. The following safety devices shall be included on the condensing unit; high pressure sensor and switch, low pressure switch, control circuit fuses, crankcase heaters, fusible plug, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter and anti-recycling timers.
12. To ensure the liquid refrigerant does not flash when supplying to the various indoor units, the circuit shall be provided with a sub-cooling feature.
13. Oil recovery cycle shall be automatic occurring 2 hours after start of operation and then every 8 hours of operation.

14. The condensing unit shall be capable of heating operation at 0°F (-18°C) dry bulb ambient temperature without additional low ambient controls or an auxiliary heat source.

**B. UNIT CABINET:**

1. The condensing unit shall be completely weatherproof and corrosion resistant. The unit shall be constructed from rust-proofed galvanized steel panels coated with a baked enamel finish.

**C. FAN:**

1. The condensing unit shall consist of one or more propeller type, direct-drive 350 or 750 W fan motors that have multiple speed operation via a DC (digitally commutating) inverter.
2. The condensing unit fan motor shall have multiple speed operation of the DC (digitally commutating) inverter type, and be of high external static pressure and shall be factory set as standard at 0.12 in. WG. A field setting switch to a maximum 0.32 in. WG pressure is available to accommodate field applied duct for indoor mounting of condensing units.
3. The fan shall be a vertical discharge configuration with a nominal airflow maximum range of 5,544 CFM to 22,283 CFM dependent on model specified.
4. The fan motor shall have inherent protection and permanently lubricated bearings and be mounted.
5. The fan motor shall be provided with a fan guard to prevent contact with moving parts.

**D. CONDENSER COIL:**

1. The condenser coil shall be manufactured from copper tubes expanded into aluminum fins to form a mechanical bond.
2. The heat exchanger coil shall be of a waffle louver fin and rifled bore tube design to ensure high efficiency performance.
3. The heat exchanger on the condensing units shall be manufactured from seamless copper tube with N-shape internal grooves mechanically bonded on to aluminum fins.
4. The fins shall be coated with an anti-corrosion hydrophilic blue coating as standard from factory with a salt spray test rating of 1000hr per ASTM test standards.
5. The outdoor coil shall have three-circuit heat exchanger design eliminating the need for a drain pan heater. The lower part of the coil shall be used for inverter cooling and be on or off during heating operation enhancing the defrost operation.
  - a. An alternate manufacturer must provide a drain pan heater to enable adequate defrosting of the unit in defrost operation.
6. The condensing unit shall be factory equipped with condenser coil guards on all sides.

**E. COMPRESSOR:**

1. The inverter scroll compressors shall be variable speed (PVM inverter) controlled which is capable of changing the speed to follow the variations in total cooling and heating load as determined by the suction gas pressure as measured in the condensing unit.

- a. In addition, samplings of evaporator and condenser temperatures shall be made so that the high/low pressures detected are read every 20 seconds and calculated. With each reading, the compressor capacity (INV frequency) shall be controlled to eliminate deviation from target value.
  - 1) Non –inverter-driven compressors, which may cause starting motor current to exceed the nominal motor current (RLA) and require larger wire sizing, shall not be allowed.
2. The inverter driven compressors in the condensing unit shall be of highly efficient reluctance DC (digitally commutating), hermetically sealed scroll “G-type” or “J-type”.
3. Neodymium magnets shall be adopted in the rotor construction to yield a higher torque and efficiency in the compressor instead of the normal ferrite magnet type.
  - a. At complete stop of the compressor, the neodymium magnets will position the rotor into the optimum position for a low torque start.
4. The capacity control range shall be as low as 10% to 100%.
5. The compressor's motor shall have a cooling system using discharge gas, to avoid sudden changes in temperature resulting in significant stresses on winding and bearings.
6. Each compressor shall be equipped with a crankcase heater, high pressure safety switch, and internal thermal overload protector.
7. Oil separators shall be standard with the equipment together with an intelligent oil management system.
8. The compressor shall be mounted on vibration dampening rubber grommets to minimize the transmission of vibration, eliminating the standard need for external spring isolation.
9. In the event of compressor failure, the remaining compressors shall continue to operate and provide heating or cooling as required at a proportionally reduced capacity. The microprocessor and associated controls shall be manually activated to specifically address this condition for single module and manifolded systems.
10. In the case of multiple condenser modules, conjoined operation hours of the compressors shall be balanced by means of a Duty Cycling Function, ensuring sequential starting of each module at each start/stop cycle, completion of oil return, completion of defrost or every 8 hours. When connected to a central control system sequential start is activated for all system on each DIII network.

## **2.05 INDOOR/EVAPORATOR UNITS**

### **A. GENERAL:**

1. Refer to drawings for equipment schedules. Mitsubishi is basis of design.
2. Service valves shall be installed in supply and return refrigerant piping near each unit and shall be accessible through access doors. Purpose of service valves is to close off refrigerant flow to each individual unit for servicing or replacement without an entire system shutdown.
3. Indoor unit is to be from the same manufacturer as the outdoor unit.
4. Indoor unit is to be fully compatible with the outdoor unit as documented by the manufacturer.
5. Dual set point functionality.



6. Compact floor mount.
7. Two-speed settings.
8. Controls to be unit-mounted in a hidden case.
9. IT Terminal Plug.

**PART 3 - EXECUTION**

**3.01 Installation, Operation, and Maintenance**

- A. Installation, Operation, and Maintenance manual shall be supplied with the unit.
- B. Installing contractor shall install unit, including field installed components, in accordance with Installation, Operation, and Maintenance manual instructions.
- C. Start up and maintenance requirements shall be complied with to ensure safe and correct operation of the unit.

**END OF SECTION 238129**

## SECTION 238233 - CONVECTORS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes hydronic convectors.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings:
  - 1. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

### PART 2 - PRODUCTS

#### 2.1 HOT-WATER CONVECTORS

- A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
  - 1. Vulcan (Basis of Design)
  - 2. Rittling
  - 3. Sterling
  - 4. For manufacturers which are not the "Basis of Design", refer to Division 01 "Product Substitution Procedures" for additional submittal and coordination requirements.
- B. Heating Elements: Seamless copper tubing mechanically expanded into evenly spaced aluminum fins and rolled into cast-iron or brass headers with inlet/outlet and air vent; steel side plates and supports. Factory-pressure-test element at minimum 150 psig.
- C. Front and Top Panel: Minimum 14 gauge steel with exposed corners rounded; removable front panels with tamper-resistant fasteners braced and reinforced for stiffness.
- D. Wall-Mounted Back and End Panels: Minimum 18 gauge steel.
- E. Support Brackets: Locate at maximum 36-inch spacing to support front panel and element.
- F. Insulation: 1/2-inch- thick, fibrous glass on inside of the back of the enclosure.
- G. Finish: Baked-enamel finish in manufacturer's custom color as selected by Architect.
- H. Access Doors: Factory made, permanently hinged with tamper-resistant fastener, minimum size 6 by 7 inches, integral with enclosure.
- I. Enclosure Style: Wall recessed.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas to receive convectors for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for hydronic-piping connections to verify actual locations before installation of convector.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install convectors level and plumb.
- B. Install valves within reach of access door provided in enclosure.
- C. Install air-seal gasket between wall and recessed flanges or front cover of fully recessed unit.
- D. Install piping within pedestals for freestanding units.

### 3.3 CONNECTIONS

- A. Piping installation requirements are specified in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect hot-water convectors and components to piping according to Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties."
  - 1. Install shutoff valves on inlet and outlet, and balancing valve on outlet.
- C. Install piping adjacent to convectors to allow service and maintenance.

### 3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
- B. Convectors will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 238233

## **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 fan coil units (with outside air intake) and cabinet unit heaters (no outside air intake) with hot-water coils.

### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include rated capacities, operating characteristics, and furnished specialties and accessories for each unit type and configuration.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Include location and size of each field connection.
  - 4. Include details of anchorages and attachments to structure and to supported equipment.
  - 5. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
  - 6. Indicate location and arrangement of piping valves and specialties.
  - 7. Wiring Diagrams: Power, signal, and control wiring.

### **1.4 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For cabinet unit heaters to include in emergency, operation, and maintenance manuals.

### **1.5 COORDINATION**

- A. Coordinate layout and installation of fan coil units and suspension system components with other construction that penetrates or is supported by ceilings, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
- B. Coordinate size and location of wall sleeves for outdoor-air intake.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
  - 1. Trane (Basis of Design)
  - 2. Carrier
  - 3. Daikin
  - 4. Johnson Controls
  - 5. For manufacturers which are not the "Basis of Design", refer to Division 01 "Product Substitution Procedures" for additional submittal and coordination requirements.

## **2.2 DESCRIPTION**

- A. Factory-assembled and -tested unit complying with AHRI 440.
- 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.

## **2.3 COIL SECTION INSULATION**

- A. Insulation Materials: ASTM C1071; surfaces exposed to airstream shall have aluminum-foil facing or erosion-resistant coating to prevent erosion of glass fibers.
  - 1. Thickness: 1/2 inch.
  - 2. Thermal Conductivity (k-Value): 0.26 Btu x in./h x sq. ft. at 75 deg F mean temperature.
  - 3. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E84.
  - 4. Adhesive: Comply with ASTM C916 and with NFPA 90A or NFPA 90B.
  - 5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- B. Insulation Materials: Comply with NFPA 90A or NFPA 90B. Unicellular polyethylene thermal plastic, preformed sheet insulation complying with ASTM C534, Type II, except for density.
  - 1. Thickness: 1/2 inch.
  - 2. Thermal Conductivity (k-Value): 0.24 Btu x in./h x sq. ft. at 75 deg F mean temperature.
  - 3. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM C411.
  - 4. Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
  - 5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

## **2.4 CABINETS**

- A. Material: Steel with baked-enamel finish with manufacturer's custom paint, in color selected by Architect.
  - 1. Vertical Unit, Exposed Front Panels: Minimum 14 gauge sheet steel, removable panels with channel-formed edges secured with tamperproof cam fasteners.
  - 2. Horizontal Unit, Exposed Bottom Panels: Minimum 18 gauge sheet steel, removable panels secured with tamperproof cam fasteners and safety chain.
  - 3. Recessed Flanges: Steel, finished to match cabinet.
  - 4. Control Access Door: Key operated.

## **2.5 FILTERS**

- A. Minimum Efficiency Reporting Value: According to ASHRAE 52.2 to be MERV 8.

## **2.6 COILS**

- A. Hot-Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain.

## **2.7 CONTROLS**

- A. Fan and Motor Board: Removable.
  - 1. Fan: Forward curved, double width, centrifugal, directly connected to motor; thermoplastic or painted-steel wheels and aluminum, painted-steel, or galvanized-steel fan scrolls.
  - 2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."
  - 3. Wiring Terminations: Connect motor to chassis wiring with plug connection.

- B. Control devices and operational sequences are specified in Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993 "Sequence of Operations for HVAC DDC."
- C. Electrical Connection: Factory-wired motors and controls for a single field connection.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine areas to receive cabinet unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping and electrical connections to verify actual locations before unit-heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION**

- A. Install wall boxes in finished wall assembly; seal and weatherproof. Joint-sealant materials and applications are specified in Section 079200 "Joint Sealants."
- B. Install cabinet unit heaters to comply with NFPA 90A.
- C. Suspend cabinet unit heaters from structure with elastomeric hangers. Vibration isolators are specified in Section 230548 "Vibration Controls for HVAC."
- D. Install new filters in each fan-coil unit within two weeks of Substantial Completion.

#### **3.3 CONNECTIONS**

- A. Piping installation requirements are specified in Section 232113 "Hydronic Piping," Section 232116 "Hydronic Piping Specialties," Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Connect piping to cabinet unit heater's factory, hot-water piping package. Install the piping package if shipped loose.
- D. Connect supply and return ducts to cabinet unit heaters with flexible duct connectors specified in Section 233300 "Air Duct Accessories."
- E. Comply with safety requirements in UL 1995.
- F. Unless otherwise indicated, install union and gate or ball valve on supply-water connection and union and calibrated balancing valve on return-water connection of cabinet unit heater. Hydronic specialties are specified in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties."
- G. Ground equipment according to Division 26 "Grounding and Bonding for Electrical Systems."
- H. Connect wiring according to Division 26 "Low-Voltage Electrical Power Conductors and Cables."

#### **3.4 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections:
  - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

- B. Units will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

**END OF SECTION 238219**

## PART 1 - GENERAL

### 1.1 SUMMARY

#### A. Section Includes:

1. PEX pipe and fittings.
2. PEX/AL/PEX pipe and fittings.
3. EPDM pipe and fittings.
4. Distribution manifolds.
5. Piping specialties.
6. Controls.

### 1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. PEX: Crosslinked polyethylene.
- C. PEX/AL/PEX: Crosslinked polyethylene/aluminum/crosslinked polyethylene.
- D. PTFE: Polytetrafluoroethylene plastic.

### 1.3 ACTION SUBMITTALS

#### A. Product Data:

1. PEX pipe and fittings.
2. PEX/AL/PEX pipe and fittings.
3. EPDM pipe and fittings.
4. Distribution manifolds.
5. Piping specialties.
6. Controls.
7. For each product, provide the following:
  - a. Data for piping, fittings, manifolds, specialties, and controls; include pressure and temperature ratings, oxygen-barrier performance, fire-performance characteristics, and water-flow and pressure-drop characteristics.

- B. Shop Drawings: Show piping size, layout, and details drawn to scale, including valves, manifolds, controls, and support assemblies, and their attachments to building structure.

1. Shop Drawing Scale: **1/4 inch = 1 foot**



1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Piping layout, or Building Information Model (BIM), drawn to scale, showing the items described in this Section and coordinated with all building trades.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For radiant-heating piping valves and equipment to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 PEX PIPE AND FITTINGS

- A. Pipe Material: PEX plastic in accordance with ASTM F876.
- B. Oxygen Barrier: Limit oxygen diffusion through the tube to maximum 0.10 mg per cu. m/day at **104 deg F** in accordance with DIN 4726.
- C. Fittings: **ASTM F1807, metal insert and copper crimp rings**
- D. Pressure/Temperature Rating: Minimum **90 psig and 180 deg F.**

2.2 EPDM PIPE AND FITTINGS

- A. Pipe Material: Crosslinked EPDM inner and outer tubes.
- B. Wall Thickness: Minimum **0.125 inch**.
- C. layer applied to the inner tube to limit oxygen diffusion through the pipe to maximum 0.10 mg per cu. m/day at **104 deg F** DIN 4726 DIN 4726.
- D. Reinforcing Braid: Braided-aluminum wire between the inner and outer tube.
- E. Fittings: ASTM F1807, copper with stainless steel crimps or clamps.
- F. Pressure/Temperature Rating: Minimum **125 psig and 180 deg F.**

2.3 DISTRIBUTION MANIFOLDS

- A. Manifold: Minimum **NPS 1, or as noted on drawings**
- B. Main Shutoff Valves:
  - 1. Factory installed on supply and return connections.
  - 2. **TwoThree**-piece body.
  - 3. Body: Brass or bronze.

4. Ball: Chrome-plated bronze.
5. Seals: PTFE.
6. CWP Rating: 125 psig
7. Maximum Operating Temperature: 180 deg F

C. Manual Air Vents:

1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Key furnished with valve or screwdriver bit.
4. Inlet Connection: NPS 1/2 (DN 15).
5. Discharge Connection: NPS 1/8 (DN 6).
6. CWP Rating: 125 psig (860 kPa).
7. Maximum Operating Temperature: 180 deg F (82 deg C).

D. Balancing Valves:

1. Body: Plastic or bronze, ball or plug, or globe cartridge type.
2. Ball or Plug: Brass or stainless steel.
3. Globe Cartridge and Washer: Brass with EPDM composition washer.
4. Seat: PTFE.
5. Visual Flow Indicator: Flow meter with visible indication in a clear plastic cap at top of valve.
6. Differential Pressure Gauge Connections: Integral seals for portable meter to measure loss across calibrated orifice.
7. Handle Style: Lever or knob, with memory stop to retain set position if used for shutoff.
8. CWP Rating: Minimum 125 psig (860 kPa).
9. Maximum Operating Temperature: 180 deg F (82 deg C).

E. Zone Control Valves:

1. Body: Plastic or bronze, ball or plug, or globe cartridge type.
2. Ball or Plug: Brass or stainless steel.
3. Globe Cartridge and Washer: Brass with EPDM composition washer.
4. Seat: PTFE.
5. Actuator: Replaceable electric motor.
6. CWP Rating: Minimum 125 psig (860 kPa).
7. Maximum Operating Temperature: 180 deg F (82 deg C).

F. Thermometers:

1. Mount on supply and return connections.
2. Case: Dry type, metal or plastic, 2-inch.
3. Element: Bimetal or other type of temperature element.
4. Movement: Mechanical, connecting element and pointer.
5. Stem: Stainless steel.
6. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
7. Pointer: Black metal.
8. Window: Plastic.
9. Connector: Rigid, back type.

10. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

- G. Mounting Brackets: Copper, or plastic- or copper-clad steel, or stainless steel, where in contact with manifold.

## 2.4 PIPING SPECIALTIES

### A. Cable Ties:

1. Fungus-inert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon cable ties.
2. Minimum Width: 1/8 inch (3 mm).
3. Tensile Strength: 20 lb (9 kg), minimum.
4. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).

### B. Floor-Mounting Clamps:

1. Two bolts, steel, with corrosion-resistant coating and smooth finish without sharp edges.
2. Minimum Thickness: 3/32 inch (2.4 mm).
3. Width: Minimum, wider than tubing.

### C. Floor-Mounting Tracks:

1. Aluminum or plastic channel track with smooth finish and no sharp edges.
2. Minimum Thickness: 1/16 inch (1.6 mm).
3. Slot Width: Snap fit to hold tubing.
4. Slot Spacing: [2-inch (50-mm)] [3-inch (75-mm)] <Insert dimension> intervals.

### D. Modular Interlocking Blocks:

1. Polypropylene snap-together blocks with grooves to support piping.
2. Galvanized sheet metal or aluminum emission plates.
3. Natural mineralboard cover panel.

## 2.5 CONTROLS

- A. Temperature-control devices and sequence of operations are specified in Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC."

### B. Wall-Mounted Thermostat:

1. Minimum temperature range from 50 to 90 deg F.
2. Manually operated with on-off switch.
3. Day and night setback and clock program with minimum four periods per day.
4. Operate pumps or open zone control valves if room temperature falls below the thermostat setting, and stop pumps or close zone control valves when room temperature rises above the thermostat setting.
5. thermostat setting is exceeded.

6. Corrosion-resistant, waterproof control enclosure.
- C. Heated-Panel Thermostat with Outdoor Temperature Reset:
1. Remote bulb unit with adjustable temperature range from **50 to 90 deg F**.
  2. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected pump.
    - a. Pump stops when outdoor-air temperature rises above **60 deg F**.
  3. Remote bulbs on capillary tube, resistance temperature device, or thermistor for directly sensing each of the following:
    - a. Supply-water temperature.
    - b. Outdoor-air temperature.
  4. Modulate zone control valves to reset supply-water temperature inversely with outdoor-air temperature as follows:
    - a. Supply-water temperature set point **110 deg F** when outdoor-air temperature is **0 deg F**.
    - b. Supply-water temperature set point **60 deg F** when outdoor-air temperature is **60 deg F**.
    - c. Supply-water temperature set point is reset inversely as outdoor-air temperature varies between high and low temperatures.
  5. Corrosion-resistant, waterproof control enclosure.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine surfaces and substrates to receive radiant-heating piping for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
1. Ensure that surfaces and pipes in contact with radiant-heating piping are free of burrs and sharp protrusions.
  2. Ensure that surfaces and substrates are level and plumb.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 APPLICATIONS

- A. Install the following types of radiant-heating piping for the applications described:
1. Piping in Interior Reinforced-Concrete Floor **PEX/AL/PEX**].

### 3.3 INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings or coordination drawings.
- B. Install radiant-heating piping continuous from the manifold through the heated panel and back to the manifold without piping joints in heated panels.
- C. Connect radiant piping to manifold in a reverse-return arrangement.
- D. Do not bend pipes in radii smaller than manufacturer's minimum bend radius dimensions.
- E. Install manifolds in accessible locations or install access panels to provide maintenance access as required in Section 083113 "Access Doors and Frames."
- F. Comply with requirements in Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties" for pipes and connections to hydronic systems and for glycol-solution fill requirements.
- G. Fire- and Smoke-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials in accordance with Section 078413 "Penetration Firestopping."
- H. Piping in Interior Reinforced-Concrete Floors
  - 1. Secure piping in concrete floors by attaching pipes to reinforcement using cable ties.
  - 2. Space cable ties a maximum of **18 inches** o.c. and at center of turns or bends.
  - 3. Maintain **2-inch** minimum cover.
  - 4. Install a sleeve of **3/8-inch-** thick, foam-type insulation or PE pipe around tubing and extending for a minimum of **10 inches** on each side of slab joints to protect the tubing passing through expansion or control joints. Anchor sleeve to slab form at control joints to provide maximum clearance for saw cut.
  - 5. Maintain minimum **40 psig** pressure in piping during concrete placement and continue for 24 hours after placement.
- I. Revise locations and elevations from those indicated as required to suit field conditions and ensure integrity of piping and as approved by Architect.
- J. After system balancing has been completed, mark balancing valves to permanently indicate final position.
- K. Perform the following adjustments before operating the system:
  - 1. Open valves to fully open position.
  - 2. Check operation of automatic valves.
  - 3. Set temperature controls so all zones call for full flow.
  - 4. Purge air from piping.
- L. After concrete or plaster heating panel has cured as recommended by concrete or plaster supplier, operate radiant-heating system as follows:

1. Start system heating at a maximum of 10 deg F above the ambient radiant-panel temperature and increase 10 deg F each following day until design temperature is achieved.
2. For freeze protection, operate at a minimum of 60 deg F supply-water temperature.

### 3.4 FIELD QUALITY CONTROL

- A. Testing Agency: **Engage** a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
  1. Prepare radiant-heating piping for testing as follows:
    - a. Open all isolation valves and close bypass valves.
    - b. Open and verify operation of zone control valves.
    - c. Flush with clean water and clean strainers.
  2. Perform the following tests and inspections **with the assistance of a factory-authorized service representative**:
    - a. Leak Test: After installation, charge system and test for leaks. Subject piping to hydrostatic test pressure that is not less than 1.5 times the design pressure but not more than 100 psig. Repair leaks and retest until no leaks exist.
    - b. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  3. Radiant-heating piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.
- D. Protect hydronic piping system from damage during construction.

END OF SECTION 238316

## SECTION 260010 - SUPPLEMENTAL REQUIREMENTS FOR ELECTRICAL

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section specifies supplemental requirements generally applicable to the Work specified in Division 26. This Section is also referenced by related Work specified in other Divisions.
- B. Related Requirements:
  - 1. Section 260011 "Facility Performance Requirements for Electrical" specifies seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

#### 1.2 REFERENCES

- A. Abbreviations and Acronyms for Electrical Terms and Units of Measure:
  - 1. 8P8C: An 8-position 8-contact modular jack.
  - 2. A: Ampere, unit of electrical current.
  - 3. AC or ac: Alternating current.
  - 4. AFCI: Arc-fault circuit interrupter.
  - 5. AIC: Ampere interrupting capacity.
  - 6. AL, Al, or ALUM: Aluminum.
  - 7. ASD: Adjustable-speed drive; also called "variable-frequency drive" (VFD).
  - 8. ATS: Automatic transfer switch.
  - 9. AWG: American wire gauge; see ASTM B258.
  - 10. BAS: Building automation system.
  - 11. BIL: Basic impulse insulation level.
  - 12. BIM: Building information modeling.
  - 13. CAD: Computer-aided design or drafting.
  - 14. CATV: Community antenna television.
  - 15. CB: Circuit breaker.
  - 16. cd: Candela, the SI fundamental unit of luminous intensity.
  - 17. CO/ALR: Copper-aluminum, revised.
  - 18. COPS: Critical operations power system.
  - 19. CU or Cu: Copper.
  - 20. CU-AL or AL-CU: Copper-aluminum.
  - 21. dB: Decibel, a unitless logarithmic ratio of two electrical, acoustical, or optical power values.
  - 22. dB(A-weighted) or dB(A): Decibel acoustical sound pressure level with A-weighting applied in accordance with IEC 61672-1.
  - 23. dB(adjusted) or dBa: Decibel weighted absolute noise power with respect to 3.16 pW (minus 85 dBm).
  - 24. dBm: Decibel absolute power with respect to 1 mW.
  - 25. DC or dc: Direct current.

- 26. DCOA: Designated critical operations area.
- 27. DDC: Direct digital control (HVAC).
- 28. EGC: Equipment grounding conductor.
- 29. ELV: Extra-low voltage.
- 30. EMF: Electromotive force.
- 31. EMI: Electromagnetic interference.
- 32. EPM: Electrical preventive maintenance.
- 33. EPS: Emergency power supply.
- 34. EPSS: Emergency power supply system.
- 35. ESS: Energy storage system.
- 36. EV: Electric vehicle.
- 37. EVPE: Electric vehicle power export equipment.
- 38. EVSE: Electric vehicle supply equipment.
- 39. fc: Footcandle, an internationally recognized unit of illuminance equal to one lumen per square foot or 10.76 lx. The simplified conversion  $1 \text{ fc} = 10 \text{ lx}$  in the Specifications is common practice and considered adequate precision for building construction activities. When there are conflicts, lux is the primary unit; footcandle is specified for convenience.
- 40. FLC: Full-load current.
- 41. ft: Foot.
- 42. ft-cd: Foot-candle, the antiquated U.S. Standard unit of illuminance, equal to one international candle measured at a distance of one foot, that was superseded in 1948 by the unit "footcandle" after the SI unit candela (cd) replaced the international candle; see "fc,"
- 43. GEC: Grounding electrode conductor.
- 44. GFCI: Ground-fault circuit interrupter.
- 45. GFPE: Ground-fault protection of equipment.
- 46. GND: Ground.
- 47. HACR: Heating, air conditioning, and refrigeration.
- 48. HDPE: High-density polyethylene.
- 49. HID: High-intensity discharge.
- 50. HP or hp: Horsepower.
- 51. HVAC: Heating, ventilating, and air conditioning.
- 52. Hz: Hertz.
- 53. IBT: Intersystem bonding termination.
- 54. inch: Inch. To avoid confusion, the abbreviation "in." is not used.
- 55. IP: Ingress protection rating (enclosures); Internet protocol (communications).
- 56. IR: Infrared.
- 57. IS: Intrinsically safe.
- 58. IT&R: Inspecting, testing, and repair.
- 59. ITE: Information technology equipment.
- 60. kAIC: Kiloampere interrupting capacity.
- 61. kcmil or MCM: One thousand circular mils.
- 62. kV: Kilovolt.
- 63. kVA: Kilovolt-ampere.
- 64. kVAr or kVAR: Kilovolt-ampere reactive.
- 65. kW: Kilowatt.
- 66. kWh: Kilowatt-hour.
- 67. LAN: Local area network.
- 68. lb: Pound (weight).
- 69. lbf: Pound (force).
- 70. LCD: Liquid-crystal display.



71. LCDI: Leakage-current detector-interrupter.
72. LED: Light-emitting diode.
73. Li-ion: Lithium-ion.
74. lm: Lumen, the SI derived unit of luminous flux.
75. LNG: Liquefied natural gas.
76. LP-Gas: Liquefied petroleum gas.
77. LRC: Locked-rotor current.
78. LV: Low voltage.
79. lx: Lux, the SI derived unit of illuminance equal to one lumen per square meter.
80. m: Meter.
81. MCC: Motor-control center.
82. MDC: Modular data center.
83. MG set: Motor-generator set.
84. MIDI: Musical instrument digital interface.
85. MLO: Main lugs only.
86. MV: Medium voltage.
87. MVA: Megavolt-ampere.
88. mW: Milliwatt.
89. MW: Megawatt.
90. MWh: Megawatt-hour.
91. NC: Normally closed.
92. Ni-Cd: Nickel-cadmium.
93. Ni-MH: Nickel-metal hydride.
94. NIU: Network interface unit.
95. NO: Normally open.
96. NPT: National (American) standard pipe taper.
97. OCPD: Overcurrent protective device.
98. ONT: Optical network terminal.
99. PC: Personal computer.
100. PCS: Power conversion system.
101. PCU: Power-conditioning unit.
102. PF or pf: Power factor.
103. PHEV: Plug-in hybrid electric vehicle.
104. PLC: Programmable logic controller.
105. PLFA: Power-limited fire alarm.
106. PoE: Power over Ethernet.
107. PV: Photovoltaic.
108. PVC: Polyvinyl chloride.
109. pW: Picowatt.
110. RFI: (electrical) Radio-frequency interference; (contract) Request for interpretation.
111. RMS or rms: Root-mean-square.
112. RPM or rpm: Revolutions per minute.
113. SCADA: Supervisory control and data acquisition.
114. SCR: Silicon-controlled rectifier.
115. SPD: Surge protective device.
116. sq.: Square.
117. SWD: Switching duty.
118. TCP/IP: Transmission control protocol/Internet protocol.
119. TEFC: Totally enclosed fan-cooled.
120. TR: Tamper resistant.
121. TVSS: Transient voltage surge suppressor.

- 122. UL: (standards) Underwriters Laboratories, Inc.; (product categories) UL, LLC.
- 123. UL CCN: UL Category Control Number.
- 124. UPS: Uninterruptible power supply.
- 125. USB: Universal serial bus.
- 126. UV: Ultraviolet.
- 127. V: Volt, unit of electromotive force.
- 128. V(ac): Volt, alternating current.
- 129. V(dc): Volt, direct current.
- 130. VA: Volt-ampere, unit of complex electrical power.
- 131. VAR: Volt-ampere reactive, unit of reactive electrical power.
- 132. VFC: Variable-frequency controller.
- 133. VOM: Volt-ohm-multimeter.
- 134. VPN: Virtual private network.
- 135. VRLA: Valve regulated lead acid; also called "sealed lead acid (SLA)" or "valve regulated sealed lead acid."
- 136. W: Watt, unit of real electrical power.
- 137. Wh: Watt-hour, unit of electrical energy usage.
- 138. WPT: Wireless power transfer.
- 139. WPTE: Wireless power transfer equipment.
- 140. WR: Weather resistant.

B. Abbreviations and Acronyms for Electrical Raceway Types:

- 1. CR: Communications raceway.
- 2. CR-GP: General-purpose communications raceway.
- 3. CR-P: Plenum communications raceway.
- 4. CR-R: Riser communications raceway.
- 5. EMT: Electrical metallic tubing.
- 6. EMT-A: Aluminum electrical metallic tubing.
- 7. EMT-S: Steel electrical metallic tubing.
- 8. EMT-SS: Stainless steel electrical metallic tubing.
- 9. ENT: Electrical nonmetallic tubing.
- 10. EPEC: Electrical HDPE underground conduit (thin wall).
- 11. EPEC-A: Type A electrical HDPE underground conduit.
- 12. EPEC-B: Type B electrical HDPE underground conduit.
- 13. ERMC: Electrical rigid metal conduit.
- 14. ERMC-A: Aluminum electrical rigid metal conduit.
- 15. ERMC-S: Steel electrical rigid metal conduit.
- 16. ERMC-S-G: Galvanized-steel electrical rigid metal conduit.
- 17. ERMC-S-PVC: PVC-coated-steel electrical rigid metal conduit.
- 18. ERMC-SS: Stainless steel electrical rigid metal conduit.
- 19. FMC: Flexible metal conduit.
- 20. FMC-A: Aluminum flexible metal conduit.
- 21. FMC-S: Steel flexible metal conduit.
- 22. FMT: Steel flexible metallic tubing.
- 23. FNMC: Flexible nonmetallic conduit. See "LFNC."
- 24. HDPE: HDPE underground conduit (thick wall).
- 25. HDPE-40: Schedule 40 HDPE underground conduit.
- 26. HDPE-80: Schedule 80 HDPE underground conduit.
- 27. IMC: Steel electrical intermediate metal conduit.
- 28. LFMC: Liquidtight flexible metal conduit.

29. LFMC-A: Aluminum liquidtight flexible metal conduit.
30. LFMC-S: Steel liquidtight flexible metal conduit.
31. LFMC-SS: Stainless steel liquidtight flexible metal conduit.
32. LFNC: Liquidtight flexible nonmetallic conduit.
33. LFNC-A: Layered (Type A) liquidtight flexible nonmetallic conduit.
34. LFNC-B: Integral (Type B) liquidtight flexible nonmetallic conduit.
35. LFNC-C: Corrugated (Type C) liquidtight flexible nonmetallic conduit.
36. OFR: Optical fiber raceway.
37. OFR-GP: General-purpose optical fiber raceway.
38. OFR-P: Plenum optical fiber raceway.
39. OFR-R: Riser optical fiber raceway.
40. PVC: Rigid PVC conduit.
41. PVC-40: Schedule 40 rigid PVC conduit.
42. PVC-80: Schedule 80 rigid PVC Conduit.
43. PVC-A: Type A rigid PVC concrete-encased conduit.
44. PVC-EB: Type EB rigid PVC concrete-encased underground conduit.
45. RGS: See ERM-C-S-G.
46. RMC: See ERM-C.
47. RTRC: Reinforced thermosetting resin conduit.
48. RTRC-AG: Low-halogen, aboveground reinforced thermosetting resin conduit.
49. RTRC-AG-HW: Heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
50. RTRC-AG-SW: Standard wall, low-halogen, aboveground reinforced thermosetting resin conduit.
51. RTRC-AG-XW: Extra heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
52. RTRC-BG: Low-halogen, belowground reinforced thermosetting resin conduit.

C. Abbreviations and Acronyms for Electrical Single-Conductor and Multiple-Conductor Cable Types:

1. AC: Armored cable.
2. CATV: Coaxial general-purpose cable.
3. CATVP: Coaxial plenum cable.
4. CATVR: Coaxial riser cable.
5. CI: Circuit integrity cable.
6. CL2: Class 2 cable.
7. CL2P: Class 2 plenum cable.
8. CL2R: Class 2 riser cable.
9. CL2X: Class 2 cable, limited use.
10. CL3: Class 3 cable.
11. CL3P: Class 3 plenum cable.
12. CL3R: Class 3 riser cable.
13. CL3X: Class 3 cable, limited use.
14. CM: Communications general-purpose cable.
15. CMG: Communications general-purpose cable.
16. CMP: Communications plenum cable.
17. CMR: Communications riser cable.
18. CMUC: Under-carpet communications wire and cable.
19. CMX: Communications cable, limited use.
20. DG: Distributed generation cable.

21. FC: Flat cable.
22. FCC: Flat conductor cable.
23. FPL: Power-limited fire-alarm cable.
24. FPLP: Power-limited fire-alarm plenum cable.
25. FPLR: Power-limited fire-alarm riser cable.
26. IGS: Integrated gas spacer cable.
27. ITC: Instrumentation tray cable.
28. ITC-ER: Instrumentation tray cable, exposed run.
29. MC: Metal-clad cable.
30. MC-HL: Metal-clad cable, hazardous location.
31. MI: Mineral-insulated, metal-sheathed cable.
32. MTW: (machine tool wiring) Moisture-, heat-, and oil-resistant thermoplastic cable.
33. MV: Medium-voltage cable.
34. NM: Nonmetallic sheathed cable.
35. NMC: Nonmetallic sheathed cable with corrosion-resistant nonmetallic jacket.
36. NMS: Nonmetallic sheathed cable with signaling, data, and communications conductors, plus power or control conductors.
37. NPLF: Non-power-limited fire-alarm circuit cable.
38. NPLFP: Non-power-limited fire-alarm circuit cable for environmental air spaces.
39. NPLFR: Non-power-limited fire-alarm circuit riser cable.
40. NUCC: Nonmetallic underground conduit with conductors.
41. OFC: Conductive optical fiber general-purpose cable.
42. OFCG: Conductive optical fiber general-purpose cable.
43. OFCP: Conductive optical fiber plenum cable.
44. OFCR: Conductive optical fiber riser cable.
45. OFN: Nonconductive optical fiber general-purpose cable.
46. OFNG: Nonconductive optical fiber general-purpose cable.
47. OFNP: Nonconductive optical fiber plenum cable.
48. OFNR: Nonconductive optical fiber riser cable.
49. P: Marine shipboard cable.
50. PLTC: Power-limited tray cable.
51. PLTC-ER: Power-limited tray cable, exposed run.
52. PV: Photovoltaic cable.
53. RHH: (high heat) Thermoset rubber, heat-resistant cable.
54. RHW: Thermoset rubber, moisture-resistant cable.
55. SA: Silicone rubber cable.
56. SE: Service-entrance cable.
57. SER: Service-entrance cable, round.
58. SEU: Service-entrance cable, flat.
59. SIS: Thermoset cable for switchboard and switchgear wiring.
60. TBS: Thermoplastic cable with outer braid.
61. TC: Tray cable.
62. TC-ER: Tray cable, exposed run.
63. TC-ER-HL: Tray cable, exposed run, hazardous location.
64. THW: Thermoplastic, heat- and moisture-resistant cable.
65. THHN: Thermoplastic, heat-resistant cable with nylon jacket outer sheath.
66. THHW: Thermoplastic, heat- and moisture-resistant cable.
67. THWN: Thermoplastic, moisture- and heat-resistant cable with nylon jacket outer sheath.
68. TW: Thermoplastic, moisture-resistant cable.
69. UF: Underground feeder and branch-circuit cable.
70. USE: Underground service-entrance cable.

71. XHH: Cross-linked polyethylene, heat-resistant cable.
72. XHHW: Cross-linked polyethylene, heat- and moisture-resistant cable.

D. Abbreviations and Acronyms for Electrical Flexible Cord Types:

1. SEO: 600 V extra-hard-usage, hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp locations.
2. SEOW: 600 V extra-hard-usage, hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp or wet locations.
3. SEOO: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp locations.
4. SEOOW: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp or wet locations.
5. SJEO: 300 V hard-usage, junior hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp locations.
6. SJEOW: 300 V hard-usage, junior hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp or wet locations.
7. SJEOO: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp locations.
8. SJEOOW: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp or wet locations.
9. SJO: 300 V hard-usage, junior hard-service cord with thermoset insulation and oil-resistant thermoset outer cover for damp locations.
10. SJOW: 300 V hard-usage, junior hard-service cord with thermoset insulation and oil-resistant thermoset outer cover for damp or wet locations.
11. SJOO: 300 V hard-usage, junior hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer cover for damp locations.
12. SJOOOW: 300 V hard-usage, junior hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer cover for damp or wet locations.
13. SJTO: 300 V hard-usage, junior hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer cover for damp locations.
14. SJTOW: 300 V hard-usage, junior hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer cover for damp or wet locations.
15. SJTOO: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer cover for damp locations.
16. SJTOOW: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer cover for damp or wet locations.
17. SO: 600 V extra-hard-usage, hard-service cord with thermoset insulation and oil-resistant thermoset outer covering for damp locations.
18. SOW: 600 V extra-hard-usage, hard-service cord with thermoset insulation and oil-resistant thermoset outer covering for damp or wet locations.
19. SOO: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer covering for damp locations.
20. SOOW: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer covering for damp or wet locations.

21. STO: 600 V extra-hard-usage, hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer covering for damp locations.
22. STOW: 600 V extra-hard-usage, hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer covering for damp or wet locations.
23. STOO: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer covering for damp locations.
24. STOOW: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer covering for damp or wet locations.

E. Definitions:

1. 8-Position 8-Contact (8P8C) Modular Jack: An unkeyed jack with up to eight contacts commonly used to terminate twisted-pair and multiconductor Ethernet cable. Also called a "TIA-1096 miniature 8-position series jack" (8PSJ), or an "IEC 8877 8-pole jack."
  - a. Be careful when suppliers use "RJ45" generically. Obsolete RJ45 jacks used for analog telephone cables have rejection keys. 8P8C jacks used for digital telephone cables and Ethernet cables do not have rejection keys.
2. Basic Impulse Insulation Level (BIL): Reference insulation level expressed in impulse crest voltage with a standard wave not longer than 1.5 times 50 microseconds and 1.5 times 40 microseconds.
3. Cable: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "cable" is (1) a conductor with insulation, or a stranded conductor with or without insulation (single-conductor cable); or (2) a combination of conductors insulated from one another (multiple-conductor cable).
4. Communications Jack: A fixed connecting device designed for insertion of a communications cable plug.
5. Communications Outlet: One or more communications jacks, or cables and plugs, mounted in a box or ring, with a suitable protective cover.
6. Conductor: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "conductor" is (1) a wire or combination of wires not insulated from one another, suitable for carrying an electric current; (2) (National Electrical Safety Code) a material, usually in the form of wire, cable, or bar, suitable for carrying an electric current; or (3) (general) a substance or body that allows a current of electricity to pass continuously along it.
7. Designated Seismic System: A system component that requires design in accordance with Ch. 13 of ASCE/SEI 7 and for which the Component Importance Factor is greater than 1.0.
8. Direct Buried: Installed underground without encasement in concrete or other protective material.
9. Enclosure: The case or housing of an apparatus, or the fence or wall(s) surrounding an installation, to prevent personnel from accidentally contacting energized parts or to protect the equipment from physical damage. Types of enclosures and enclosure covers include the following:
  - a. Cabinet: An enclosure that is designed for either surface mounting or flush mounting and is provided with a frame, mat, or trim in which a swinging door or doors are or can be hung.
  - b. Concrete Box: A box intended for use in poured concrete.

- c. Conduit Body: A means for providing access to the interior of a conduit or tubing system through one or more removable covers at a junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
  - d. Conduit Box: A box having threaded openings or knockouts for conduit, EMT, or fittings.
  - e. Cutout Box: An enclosure designed for surface mounting that has swinging doors or covers secured directly to and telescoping with the walls of the enclosure.
  - f. Device Box: A box with provisions for mounting a wiring device directly to the box.
  - g. Extension Ring: A ring intended to extend the sides of an outlet box or device box to increase the box depth, volume, or both.
  - h. Floor Box: A box mounted in the floor intended for use with a floor box cover and other components to complete the floor box enclosure.
  - i. Floor-Mounted Enclosure: A floor box and floor box cover assembly with means to mount in the floor that is sealed against the entrance of scrub water at the floor level.
  - j. Floor Nozzle: An enclosure used on a wiring system, intended primarily as a housing for a receptacle, provided with a means, such as a collar, for surface-mounting on a floor, which may or may not include a stem to support it above the floor level, and is sealed against the entrance of scrub water at the floor level.
  - k. Junction Box: A box with a blank cover that joins different runs of raceway or cable and provides space for connection and branching of the enclosed conductors.
  - l. Outlet Box: A box that provides access to a wiring system having pryout openings, knockouts, threaded entries, or hubs in either the sides or the back, or both, for the entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting an outlet box cover, but without provisions for mounting a wiring device directly to the box.
  - m. Pedestal Floor Box Cover: A floor box cover that, when installed as intended, provides a means for typically vertical or near-vertical mounting of receptacle outlets above the floor's finished surface.
  - n. Pull Box: A box with a blank cover that joins different runs of raceway and provides access for pulling or replacing the enclosed cables or conductors.
  - o. Raised-Floor Box: A floor box intended for use in raised floors.
  - p. Recessed Access Floor Box: A floor box with provisions for mounting wiring devices below the floor surface.
  - q. Recessed Access Floor Box Cover: A floor box cover with provisions for passage of cords to recessed wiring devices mounted within a recessed floor box.
  - r. Ring: A sleeve, which is not necessarily round, used for positioning a recessed wiring device flush with the plaster, concrete, drywall, or other wall surface.
  - s. Ring Cover: A box cover, with raised center portion to accommodate a specific wall or ceiling thickness, for mounting wiring devices or luminaires flush with the surface.
  - t. Termination Box: An enclosure designed for installation of termination base assemblies consisting of bus bars, terminal strips, or terminal blocks with provision for wire connectors to accommodate incoming or outgoing conductors, or both.
10. Emergency Systems: Those systems legally required and classed as emergency by municipal, state, federal, or other codes, or by any governmental agency having jurisdiction that are designed to ensure continuity of lighting, electrical power, or both, to

- designated areas and equipment in the event of failure of the normal supply for safety to human life.
11. Essential Electrical Systems: (healthcare facilities) Those systems designed to ensure continuity of electrical power to designated areas and functions of a healthcare facility during disruption of normal power sources, and also to minimize disruption within the internal wiring system.
  12. Fault Limited: Providing or being served by a source of electrical power that is limited to not more than 100 W when tested in accordance with UL 62368-1.
    - a. The term "fault limited" is intended to encompass most Class 1, 2, and 3 power-limited sources complying with Article 725 of NFPA 70; Class ES1 and ES2 electrical energy sources that are Class PS1 electrical power sources (e.g., USB); and Class ES3 electrical energy sources that are Class PS1 and PS2 electrical power sources (e.g., PoE). See UL 62368-1 for discussion of classes of electrical energy sources and classes of electrical power sources.
  13. High-Performance Building: A building that integrates and optimizes on a life-cycle basis all major high-performance attributes, including energy conservation, environment, safety, security, durability, accessibility, cost-benefit, productivity, sustainability, functionality, and operational considerations.
  14. Jacket: A continuous nonmetallic outer covering for conductors or cables.
  15. Luminaire: A complete lighting unit consisting of a light source such as a lamp, together with the parts designed to position the light source and connect it to the power supply. It may also include parts to protect the light source or the ballast or to distribute the light.
  16. Mode: The terms "Active Mode," "Off Mode," and "Standby Mode" are used as defined in the Energy Independence and Security Act (EISA) of 2007.
  17. Multi-Outlet Assembly: A type of surface, flush, or freestanding raceway designed to hold conductors, receptacles, and switches, assembled in the field or at the factory.
  18. Plenum: A compartment or chamber to which one or more air ducts are connected and that forms part of the air distribution system.
  19. Receptacle: A fixed connecting device arranged for insertion of a power cord plug. Also called a power jack.
  20. Receptacle Outlet: One or more receptacles mounted in a box with a suitable protective cover.
  21. Sheath: A continuous metallic covering for conductors or cables.
  22. UL Category Control Number (CCN): An alphabetic or alphanumeric code used to identify product categories covered by UL's Listing, Classification, and Recognition Services.
  23. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:
    - a. Control Voltage: Having electromotive force between any two conductors, or between a single conductor and ground, that is supplied from a battery or other Class 2 or Class 3 power-limited source.
    - b. Line Voltage: (1) (controls) Designed to operate using the supplied low-voltage power without transformation. (2) (transmission lines, transformers, SPDs) The line-to-line voltage of the supplying power system.
    - c. Extra-Low Voltage (ELV): Not having electromotive force between any two conductors, or between a single conductor and ground, exceeding 30 V(ac rms), 42 V(ac peak), or 60 V(dc).



- d. Low Voltage (LV): Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 30 V but not exceeding 1000 V.
  - e. Medium Voltage (MV): Having electromotive force between any two conductors, or between a single conductor and ground, that is rated about 1 kV but not exceeding 69 kV.
  - f. High Voltage: (1) (circuits) Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 69 kV but not exceeding 230 kV. (2) (safety) Having sufficient electromotive force to inflict bodily harm or injury.
24. Wire: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "wire" is a slender rod or filament of drawn metal. A group of small wires used as a single wire is properly called a "stranded wire." A wire or stranded wire covered with insulation is properly called an "insulated wire" or a "single-conductor cable." Nevertheless, when the context indicates that the wire is insulated, the term "wire" will be understood to include the insulation.

### 1.3 COORDINATION

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions:
  - 1. Notify Construction Manager and Owner no fewer than seven days in advance of proposed interruption of electrical service.
  - 2. Do not proceed with interruption of electrical service without Construction Manager's written permission.
  - 3. Coordinate interruption with systems impacted by outage including, but not limited to, the following:
    - a. Exercising generators.
    - b. Emergency lighting.
    - c. Elevators.
    - d. Fire-alarm systems.
- B. Arrange to provide temporary electrical service or power in accordance with requirements specified in Division 01.

### 1.4 PREINSTALLATION MEETINGS

- A. Electrical Preconstruction Conference: Schedule conference with Architect and Owner, not later than **10** days after notice to proceed. Agenda topics include, but are not limited to, the following:
  - 1. Electrical installation schedule.
  - 2. Status of power system studies.
  - 3. Value analysis proposals and requests for substitution of electrical equipment.
  - 4. Utility work coordination and class of service requests.
  - 5. Commissioning activities.

1.5 SEQUENCING

- A. Conduct and submit results of power system studies before submitting Product Data and Shop Drawings for electrical equipment.

1.6 INFORMATIONAL SUBMITTALS

- A. Seismic-load performance certificates.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.8 QUALITY ASSURANCE

- A. Qualifications: Prepare and submit qualification statements for the following entities performing Work on Project:
  - 1. Structural Professional Engineer: Professional engineer possessing active qualifications specified in Section 014000 "Quality Requirements," with expertise in structural engineering, including seismic- and wind-load modeling and analysis.
  - 2. Electrical Professional Engineer: Professional engineer possessing active qualifications specified in Section 014000 "Quality Requirements," with expertise in electrical engineering, including electrical power system modeling and analysis of electrical safety in accordance with NFPA 70E.
  - 3. EPM Specialist: Recognized experts possessing the following qualifications in accordance with Section 014000 "Quality Requirements" and NFPA 70B:
    - a. Technical Competence: Person should, by education, training, and experience, be well-rounded in all aspects of electrical maintenance.
    - b. Administrative and Supervisory Skills: Person should be skilled in planning and development of long-range objectives to achieve specific results and should be able to command respect and solicit cooperation of persons involved in EPM Program development.
  - 4. Medium-Voltage Cable Installer: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" with training and manufacturer certification to install, splice, and terminate medium-voltage cable in accordance with electrical utility service provider's requirements.
    - a. Medium-voltage cable Installer must be approved by Consolidated Edison (Con-Ed).
  - 5. Generator Set Installers: Installer possessing active qualifications specified in Section 014000 "Quality Requirements," and able to present unexpired certified Installer credentials issued by generator set manufacturer prior to starting installation.
  - 6. Low-Voltage Electrical Testing and Inspecting Agency: Entities possessing active credentials from a qualified electrical testing laboratory recognized by authorities having jurisdiction.

- a. On-site electrical testing supervisors must have documented certification and experience with testing electrical equipment in accordance with NETA testing standards.
7. Medium-Voltage Electrical Testing and Inspecting Agency: Entities possessing active credentials from a qualified electrical testing laboratory recognized by authorities having jurisdiction.
  - a. On-site electrical testing supervisors must have documented certification and experience with testing electrical equipment in accordance with NETA testing standards.
8. Power-Limited Electrical Testing Agency: Entity possessing active credentials from a qualified electrical testing laboratory recognized by authorities having jurisdiction.
  - a. On-site power-limited testing supervisor must have BICSI Registered Communications Distribution Designer certification and documented training and experience with testing power-limited equipment in accordance with NETA testing standards.
9. Structural Testing and Inspecting Agency: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" with documented training and experience with testing structural concrete, seismic controls, and wind-load controls.
10. Outdoor Pole Testing and Inspecting Agency: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" with documented training and experience in accordance with ASTM C1093 for foundation testing and inspections.
11. Luminaire Photometric Testing Laboratory: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" accredited under the NVLAP for Energy Efficient Lighting Products, and complying with applicable IES testing standards.
12. Lighting Testing and Inspecting Agency: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" with documented training and experience with testing and inspecting lighting installations in accordance with IES LM-5.

B. Certifications:

1. Seismic-Load Performance Certificates: Provide special certification for designated seismic systems as indicated in Paragraph 13.2.2 "Special Certification Requirements for Designated Seismic Systems" of [ASCE/SEI 7-05] [ASCE/SEI 7-10] [ASCE/SEI 7-16] for all designated seismic-load systems identified on Drawings or in the Specifications.
  - a. Include the following information:
    - 1) Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
    - 2) Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
    - 3) Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
    - 4) Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.

- 5) Provide equipment manufacturer's written certification for each designated active electrical seismic device and system, stating that it will remain operable following the design earthquake. Certification must be based on requirements of ASCE/SEI 7, including shake table testing per ICC-ES AC156 or a similar nationally recognized testing standard procedure acceptable to authorities having jurisdiction
  - 6) Provide equipment manufacturer's written certification that components with hazardous contents maintain containment following the design earthquake by methods required in ASCE/SEI 7-16.
  - 7) Submit evidence demonstrating compliance with these requirements for approval to authorities having jurisdiction after review and acceptance by qualified structural professional engineer.
- b. The following systems and components are Designated Seismic Systems and require written special certification of seismic qualification by manufacturer:
- 1) Hangers and supports specified in Section 260529 "Hangers and Supports for Electrical Systems."
  - 2) Conduits and their mounting provisions specified in Section 260533.13 "Conduits for Electrical Systems."
  - 3) Seismic restraints specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
  - 4) Equipment, accessories, and components specified in Section 262413 "Switchboards."
  - 5) Equipment, accessories, and components specified in Section 262416 "Panelboards."
  - 6) Equipment, accessories, and components specified in Section 262816 "Enclosed Switches and Circuit Breakers."
  - 7) Equipment, accessories, and components specified in Section 263213.13 "Diesel-Engine-Driven Generator Sets."
  - 8) Equipment, accessories, and components specified in Section 263600 "Transfer Switches."

## PART 2 - PRODUCTS

### 2.1 SUBSTITUTION LIMITATIONS FOR ELECTRICAL EQUIPMENT

A. Substitution requests for electrical equipment will be entertained under the following conditions:

1. Notification of Contractor's intent to request substitutions for convenience must be declared during the Electrical Preconstruction Conference so potential risks to system performance and construction schedule may be identified for Contractor's response in submission of the substitution request. Submission of requests for substitutions for convenience must meet the conditions and deadline specified in Section 012500 "Substitution Procedures" to receive approval.
2. For electrical equipment and systems, substitutions for cause are considered major construction risks. If it is possible that Contractor may need to request substitutions for cause because of equipment unavailability, or inability to meet construction schedule

because of lead time, Contractor must declare the possibility during the Electrical Preconstruction Conference to permit establishing a mitigation plan for minimizing risks to system performance and construction schedule.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Electrical Installation Schedule: At preconstruction meeting, and periodically thereafter as dates change, provide schedule for electrical installation Work to Owner and Architect including, but not limited to, milestone dates for the following activities:
1. Submission of power system studies.
  2. Submission of specified coordination drawings.
  3. Submission of action submittals specified in Division 26.
  4. Orders placed for major electrical equipment.
  5. Arrival of major electrical equipment on-site.
  6. Preinstallation meetings specified in Division 26.
  7. Utility service outages.
  8. Utility service inspection and activation.
  9. Closing of walls and ceilings containing electrical Work.
  10. System startup, testing, and commissioning activities for major electrical equipment.
  11. System startup, testing, and commissioning activities for emergency lighting.
  12. System startup, testing, and commissioning activities for automation systems (SCADA, BMS, lighting, HVAC, fire alarm, fire pump, etc.).
  13. Pouring of concrete housekeeping pads for electrical equipment and testing of concrete samples.
  14. Requests for special inspections.
  15. Requests for inspections by authorities having jurisdiction.
- B. Coordination Drawings for Structural Supports: Show coordination of structural supports for equipment and devices, including restraints and bracing for control of seismic and wind loads, with other systems, equipment, and structural supports in the vicinity.
- C. Coordination Drawings for Large Equipment Outdoor Installations:
1. Utilities site plan, drawn to scale, showing heavy equipment or truck access paths for maintenance and replacement, with the following items shown and coordinated with each other, based on input from installers of the items involved:
    - a. Fences and walls, dimensioned concrete bases, outlines of equipment, conduit entries, and grounding and bonding locations.
    - b. Indicate clear dimensions for fence gates and wall openings.
    - c. Indicate depth and type of ground cover, and locations of trees, shrubbery, and other obstructions in access path.
    - d. Indicate clear height below tree branches, overhead lines, bridges, and other overhead obstructions in access path, or where cranes and hoists will be needed to handle large electrical equipment.

- e. Support locations, type of support, and weight on each support. Locate structural supports for structure-supported raceways[, **busways,**] [**and seismic bracing**].
- f. Dimensioned working clearances and dedicated areas around electrical equipment.

D. Coordination Drawings for Duct Banks:

- 1. Show duct profiles and coordination with other utilities and underground structures.
- 2. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.

3.2 INSTALLATION OF ELECTRICAL WORK

- A. Unless more stringent requirements are specified in the Contract Documents or manufacturers' written instructions, comply with NFPA 70 and NECA NEIS 1 for installation of Work specified in Division 26. Consult Architect for resolution of conflicting requirements.

3.3 FIELD QUALITY CONTROL

A. Adminstrant for Medium-Voltage Electrical Tests and Inspections:

- 1. CM will engage qualified medium-voltage electrical testing and inspecting agency to administer and perform tests and inspections.
- 2. Engage qualified medium-voltage electrical testing and inspecting agency to administer and perform tests and inspections.
- 3. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
- 4. Administer and perform tests and inspections.

B. Adminstrant for Low-Voltage Electrical Tests and Inspections:

- 1. Engage qualified low-voltage electrical testing and inspecting agency to administer and perform tests and inspections.

C. Adminstrant for Structural Tests and Inspections:

- 1. Engage qualified structural testing and inspecting agency to administer and perform tests and inspections.

D. Adminstrant for Field Tests and Inspections of Lighting Installations:

- 1. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.

3.4 CLOSEOUT ACTIVITIES

A. Operation and Maintenance Data: Prepare and submit the following:

- 1. Provide emergency operation, normal operation, and preventive maintenance manuals for each system and equipment installed.

2. Include the following information:
  - a. Manufacturer's operating specifications.
  - b. User's guides for software and hardware.
  - c. Schedule of maintenance material items recommended to be stored at Project site.
  - d. Detailed instructions covering operation under both normal and abnormal conditions.
  - e. Time-current curves for overcurrent protective devices and manufacturer's written instructions for testing and adjusting their settings.
  - f. List of load-current and overload-relay heaters with related motor nameplate data.
  - g. List of lamp types and photoelectric relays used on Project, with ANSI and manufacturers' codes.
  - h. Manufacturer's instructions for setting field-adjustable components.
  - i. Manufacturer's instructions for testing, adjusting, and reprogramming microprocessor controls.
  - j. EPSS: Manufacturer's system checklists, maintenance schedule, and maintenance log sheets in accordance with NFPA 110.
  - k. Exterior pole inspection and repair procedures.
  - l. Include copies of demonstration and training videos.
- B. Demonstration: Demonstrate to Owner's maintenance and clerical personnel how to operate the following systems and equipment:
  1. Lighting control devices specified in Section 260923 "Lighting Control Devices."
- C. Training: With assistance from factory-authorized service representatives, train Owner's maintenance personnel on the following topics:
  1. How to operate normal and emergency electrical systems, including justifications for, and limitations of, protective device settings recommended in study report specified in Section 260573.16 "Coordination Studies."
  2. Electrical power safety fundamentals refresher including arc-flash hazard safety features of electrical power distribution equipment in facility, interpreting arc-flash warning labels, selecting appropriate personal protective equipment, and understanding significance of findings documented in study report specified in Section 260573.19 "Arc-Flash Hazard Analysis."
  3. How to adjust, operate, and maintain devices specified in Section 260923 "Lighting Control Devices."
  4. How to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories specified in Section 262413 "Switchboards."
  5. How to adjust, operate, and maintain equipment specified in Section 263100 "Photovoltaic Collectors."
  6. How to adjust, operate, and maintain equipment specified in Section 263213.13 "Diesel-Engine-Driven Generator Sets."
  7. How to adjust, operate, and maintain transfer switches and related equipment, including ground-fault protection system, specified in Section 263600 "Transfer Switches."
  8. How to adjust, operate, and maintain luminaires and controls specified in Section 26500 "Lighting."

END OF SECTION 260010

## SECTION 260011 - FACILITY PERFORMANCE REQUIREMENTS FOR ELECTRICAL

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Field conditions and other facility performance requirements applicable to Work specified in Division 26.

#### 1.2 FIELD CONDITIONS

##### A. Seismic Hazard Design Loads:

1. Unless otherwise indicated on Contract Documents, specified Work must withstand seismic hazard design loads determined in accordance with requirements specified in this Section, adjusted for installed elevation above or below grade.
  - a. The term "withstand" means "unit must remain in place without separation of parts from unit when subjected to specified seismic hazard design loads and unit must be fully operational after seismic event."
2. Perform calculations to obtain force information necessary to properly select seismic-restraint devices, fasteners, and anchorage. Perform calculations using methods acceptable to applicable code authorities and as presented in ASCE/SEI 7-16. Where "ASCE/SEI 7" is used throughout this Section, it must be understood that the edition referred to in this subparagraph is the edition intended as reference throughout the Section Text.
  - a. Data indicated below to be determined by Delegated Design Contractor must be obtained by Contractor and must be included in individual component submittal packages.
  - b. Coordinate seismic design calculations with wind-load calculations for equipment mounted outdoors.
  - c. Building Risk Category: **IV**.
  - d. Building Site Classification: **C**.
3. Calculation Factors, ASCE/SEI 7-16, Ch. 13 - Seismic Design Requirements for Nonstructural Components: All section, paragraph, equation, and table numbers refer to ASCE/SEI 7-16 unless otherwise indicated.
  - a. Horizontal Seismic Design Force  $F_p$ : Value must be calculated by Delegated Design Contractor using Equation 13.3-1. Factors below must be obtained for this calculation:
    - 1) Spectral Acceleration ( $S_{DS}$ ): 0.296. Value applies to all components on Project.



- 2) Component Amplification Factor ( $a_p$ ): See Drawing Schedule for each component.
  - 3) Component Importance Factor ( $I_p$ ): See Drawing Schedule for each component.
  - 4) Component Operating Weight ( $W_p$ ): For each component. Obtain by Delegated Design Contractor from each component submittal.
  - 5) Component Response Modification Factor ( $R_p$ ): See Drawing Schedule for each component.
  - 6) Height in Structure of Point of Attachment of Component for Base ( $z$ ): Determine from Project Drawings for each component by Delegated Design Contractor. For items at or below the base, "z" must be taken as zero.
  - 7) Average Roof Height of Structure for Base ( $h$ ): Determine from Project Drawings by Delegated Design Contractor.
- b. Vertical Seismic Design Force: Calculated by Delegated Design Contractor using method explained in ASCE/SEI 7-16, Paragraph 13.3.1.2.
- c. Seismic Relative Displacement ( $D_{pl}$ ): Calculated by Delegated Design Contractor using methods explained in ASCE/SEI 7-16, Paragraph 13.3.2. Factors below must be obtained for this calculation:
- 1) Relative Seismic Displacement that Each Component Must Be Designed to Accommodate ( $D_p$ ): Calculated by Delegated Design Contractor in accordance with ASCE/SEI 7-16, Paragraph 13.3.2.
  - 2) Structure Importance Factor ( $I_e$ ): 1.5. Value applies to all components on Project.
  - 3) Deflection at Building Level x of Structure A ( $\delta_{xA}$ ): See Drawing Schedule for each component.
  - 4) Deflection at Building Level y of Structure A ( $\delta_{yA}$ ): See Drawing Schedule for each component.
  - 5) Deflection at Building Level y of Structure B ( $\delta_{yB}$ ): See Drawing Schedule for each component.
  - 6) Height of Level x to Which Upper Connection Point Is Attached ( $h_x$ ): Determine for each component by Delegated Design Contractor from Project Drawings and manufacturer's data.
  - 7) Height of Level y to Which Upper Connection Point Is Attached ( $h_y$ ): Determine for each component by Delegated Design Contractor from Project Drawings and manufacturer's data.
  - 8) Allowable Story Drift for Structure A ( $\Delta_{aA}$ ): See Drawing Schedule for each component.
  - 9) Allowable Story Drift for Structure B ( $\Delta_{aB}$ ): See Drawing Schedule for each component.
  - 10) Story Height Used in the Definition of the Allowable Drift  $\Delta_a$  ( $h_{sx}$ ): See Drawings Schedules for each component.
- d. Component Fundamental Period ( $T_p$ ): Calculated by Delegated Design Contractor using methods explained in ASCE/SEI 7-16, Paragraph 13.3.3. Factors below must be obtained for this calculation:
- 1) Component Operating Weight ( $W_p$ ): Determined by Contractor from Project Drawings and manufacturer's data.
  - 2) Gravitational Acceleration ( $g$ ): 32.17 ft./s<sup>2</sup> (9.81 m/s<sup>2</sup>).

- 3) Combined Stiffness of the Component, Supports, and Attachments ( $K_p$ ):  
Determined by delegated design seismic engineer.

B. Wind Hazard Design Loads:

1. Perform calculations to obtain force information necessary to properly select wind-load restraint devices, fasteners, and anchorage. Perform calculations using methods acceptable to applicable code authorities and as presented in **ASCE/SEI 7-16**. Where "ASCE/SEI 7" is used throughout this Section, it must be understood that the edition referred to in this subparagraph is intended as referenced throughout the Section Text unless otherwise indicated.
  - a. Data indicated below that are specific to individual pieces of equipment must be obtained by Contractor and must be included in individual component submittal packages.
  - b. Coordinate design wind-load calculations with seismic-load calculations for equipment requiring both seismic- and wind-load reinforcement. Comply with requirements in other Sections in addition to those in this Section.
2. Design wind pressure "p" for external sidewall-mounted equipment must be calculated by Delegated Design Contractor using methods in ASCE/SEI 7-16, Ch. 30. Perform calculations according to one of the following, as appropriate:
  - a. PART 1: Low-Rise Buildings.
  - b. PART 2: Low-Rise Buildings (Simplified).
  - c. PART 3: Buildings with "h" less than 60 ft. (18.3 m).
  - d. PART 4: Buildings with "h" greater than 60 ft. (18.3 m) and less than 160 ft. (48.8 m).
  - e. PART 5: Open Buildings.

C. Temperature Variation: Allow for thermal movements from the following differential temperatures:

1. Ambient Temperature Differential: 120 deg F (67 deg C).
2. Material Surface Temperature Differential: 180 deg F (100 deg C).
3. Ground Surface Temperature Differential to 10 ft. (3 m) Depth.

D. Ground Water:

1. Assume ground-water level is at grade level unless a lower water table is noted on Drawings.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 260011

## SECTION 260011 - FACILITY PERFORMANCE REQUIREMENTS FOR ELECTRICAL

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Field conditions and other facility performance requirements applicable to Work specified in Division 26.

#### 1.2 FIELD CONDITIONS

##### A. Seismic Hazard Design Loads:

1. Unless otherwise indicated on Contract Documents, specified Work must withstand seismic hazard design loads determined in accordance with requirements specified in this Section, adjusted for installed elevation above or below grade.
  - a. The term "withstand" means "unit must remain in place without separation of parts from unit when subjected to specified seismic hazard design loads and unit must be fully operational after seismic event."
2. Perform calculations to obtain force information necessary to properly select seismic-restraint devices, fasteners, and anchorage. Perform calculations using methods acceptable to applicable code authorities and as presented in ASCE/SEI 7-16. Where "ASCE/SEI 7" is used throughout this Section, it must be understood that the edition referred to in this subparagraph is the edition intended as reference throughout the Section Text.
  - a. Data indicated below to be determined by Delegated Design Contractor must be obtained by Contractor and must be included in individual component submittal packages.
  - b. Coordinate seismic design calculations with wind-load calculations for equipment mounted outdoors.
  - c. Building Risk Category: **IV**.
  - d. Building Site Classification: **C**.
3. Calculation Factors, ASCE/SEI 7-16, Ch. 13 - Seismic Design Requirements for Nonstructural Components: All section, paragraph, equation, and table numbers refer to ASCE/SEI 7-16 unless otherwise indicated.
  - a. Horizontal Seismic Design Force  $F_p$ : Value must be calculated by Delegated Design Contractor using Equation 13.3-1. Factors below must be obtained for this calculation:
    - 1) Spectral Acceleration ( $S_{DS}$ ): 0.296. Value applies to all components on Project.

- 2) Component Amplification Factor ( $a_p$ ): See Drawing Schedule for each component.
  - 3) Component Importance Factor ( $I_p$ ): See Drawing Schedule for each component.
  - 4) Component Operating Weight ( $W_p$ ): For each component. Obtain by Delegated Design Contractor from each component submittal.
  - 5) Component Response Modification Factor ( $R_p$ ): See Drawing Schedule for each component.
  - 6) Height in Structure of Point of Attachment of Component for Base ( $z$ ): Determine from Project Drawings for each component by Delegated Design Contractor. For items at or below the base, "z" must be taken as zero.
  - 7) Average Roof Height of Structure for Base ( $h$ ): Determine from Project Drawings by Delegated Design Contractor.
- b. Vertical Seismic Design Force: Calculated by Delegated Design Contractor using method explained in ASCE/SEI 7-16, Paragraph 13.3.1.2.
- c. Seismic Relative Displacement ( $D_{pi}$ ): Calculated by Delegated Design Contractor using methods explained in ASCE/SEI 7-16, Paragraph 13.3.2. Factors below must be obtained for this calculation:
- 1) Relative Seismic Displacement that Each Component Must Be Designed to Accommodate ( $D_p$ ): Calculated by Delegated Design Contractor in accordance with ASCE/SEI 7-16, Paragraph 13.3.2.
  - 2) Structure Importance Factor ( $I_e$ ): 1.5. Value applies to all components on Project.
  - 3) Deflection at Building Level x of Structure A ( $\delta_{xA}$ ): See Drawing Schedule for each component.
  - 4) Deflection at Building Level y of Structure A ( $\delta_{yA}$ ): See Drawing Schedule for each component.
  - 5) Deflection at Building Level y of Structure B ( $\delta_{yB}$ ): See Drawing Schedule for each component.
  - 6) Height of Level x to Which Upper Connection Point Is Attached ( $h_x$ ): Determine for each component by Delegated Design Contractor from Project Drawings and manufacturer's data.
  - 7) Height of Level y to Which Upper Connection Point Is Attached ( $h_y$ ): Determine for each component by Delegated Design Contractor from Project Drawings and manufacturer's data.
  - 8) Allowable Story Drift for Structure A ( $\Delta_{aA}$ ): See Drawing Schedule for each component.
  - 9) Allowable Story Drift for Structure B ( $\Delta_{aB}$ ): See Drawing Schedule for each component.
  - 10) Story Height Used in the Definition of the Allowable Drift  $\Delta_a$  ( $h_{sx}$ ): See Drawings Schedules for each component.
- d. Component Fundamental Period ( $T_p$ ): Calculated by Delegated Design Contractor using methods explained in ASCE/SEI 7-16, Paragraph 13.3.3. Factors below must be obtained for this calculation:
- 1) Component Operating Weight ( $W_p$ ): Determined by Contractor from Project Drawings and manufacturer's data.
  - 2) Gravitational Acceleration ( $g$ ): 32.17 ft./s<sup>2</sup> (9.81 m/s<sup>2</sup>).

- 3) Combined Stiffness of the Component, Supports, and Attachments ( $K_p$ ):  
Determined by delegated design seismic engineer.

B. Wind Hazard Design Loads:

1. Perform calculations to obtain force information necessary to properly select wind-load restraint devices, fasteners, and anchorage. Perform calculations using methods acceptable to applicable code authorities and as presented in **ASCE/SEI 7-16**. Where "ASCE/SEI 7" is used throughout this Section, it must be understood that the edition referred to in this subparagraph is intended as referenced throughout the Section Text unless otherwise indicated.
  - a. Data indicated below that are specific to individual pieces of equipment must be obtained by Contractor and must be included in individual component submittal packages.
  - b. Coordinate design wind-load calculations with seismic-load calculations for equipment requiring both seismic- and wind-load reinforcement. Comply with requirements in other Sections in addition to those in this Section.
2. Design wind pressure "p" for external sidewall-mounted equipment must be calculated by Delegated Design Contractor using methods in ASCE/SEI 7-16, Ch. 30. Perform calculations according to one of the following, as appropriate:
  - a. PART 1: Low-Rise Buildings.
  - b. PART 2: Low-Rise Buildings (Simplified).
  - c. PART 3: Buildings with "h" less than 60 ft. (18.3 m).
  - d. PART 4: Buildings with "h" greater than 60 ft. (18.3 m) and less than 160 ft. (48.8 m).
  - e. PART 5: Open Buildings.

C. Temperature Variation: Allow for thermal movements from the following differential temperatures:

1. Ambient Temperature Differential: 120 deg F (67 deg C).
2. Material Surface Temperature Differential: 180 deg F (100 deg C).
3. Ground Surface Temperature Differential to 10 ft. (3 m) Depth.

D. Ground Water:

1. Assume ground-water level is at grade level unless a lower water table is noted on Drawings.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 260011

## SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Copper building wire.
2. Metal-clad cable, Type MC.
3. Photovoltaic cable, Type PV.
4. Fire-alarm wire and cable.
5. Connectors and splices.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

#### 1.2 ACTION SUBMITTALS

A. Product Data:

1. Copper building wire.
2. Aluminum building wire.
3. Metal-clad cable, Type MC.
4. Photovoltaic cable, Type PV.
5. Fire-alarm wire and cable.
6. Connectors and splices.

B. Product Schedule: Indicate type, use, location, and termination locations.

#### 1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

## PART 2 - PRODUCTS

### 2.1 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Standards:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
  - 2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- C. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- D. Conductor Insulation:
  - 1. Type THHN and Type THWN-2. Comply with UL 83.
  - 2. Type XHHW-2. Comply with UL 44.

### 2.2 METAL-CLAD CABLE, TYPE MC

- A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.
- B. Standards:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
  - 2. Comply with UL 1569.
  - 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- C. Circuits:
  - 1. Single circuit with color-coded conductors.
- D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- E. Ground Conductor: Insulated.
- F. Conductor Insulation:
  - 1. Type TFN/THHN/THWN-2. Comply with UL 83.
  - 2. Type XHHW-2. Comply with UL 44.
- G. Armor: Steel, interlocked.

## 2.3 FIRE-ALARM WIRE AND CABLE

- A. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.
- B. Signaling Line Circuits: Twisted, shielded pair, not less than No. 18 AWG, or as recommended by system manufacturer.
- C. Non-Power-Limited Circuits: Solid-copper conductors with 600 V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.
  - 1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.
  - 2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.

## 2.4 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.
- C. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
  - 1. Material: Copper.
  - 2. Type: One hole with standard barrels.
  - 3. Termination: Compression.

## PART 3 - EXECUTION

### 3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders:
  - 1. Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits:
  - 1. Copper:
    - a. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.
- C. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.



3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type XHHW-2, single conductors in raceway.
- B. Indoor Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.
- C. Indoor Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- D. Outdoor Exposed Feeders: Type XHHW-2, single conductors in raceway.
- E. Outdoor Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway, or, Metal-clad cable, Type MC.
- G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.
- H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless steel, wire-mesh, strain relief device at terminations to suit application.

3.3 INSTALLATION, GENERAL

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points in accordance with Section 260533.13 "Conduits for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 INSTALLATION OF FIRE-ALARM WIRE AND CABLE

- A. Comply with NFPA 72.
- B. Wiring Method: Install wiring in metal pathway according to Section 260529 "Hangers and Supports for Electrical Systems."

1. Install plenum cable in environmental airspaces, including plenum ceilings.
  2. Fire-alarm circuits and equipment control wiring associated with fire-alarm system must be installed in a dedicated pathway system.
    - a. Cables and pathways used for fire-alarm circuits, and equipment control wiring associated with fire-alarm system, may not contain any other wire or cable.
  3. Fire-Rated Cables: Use of two-hour, fire-rated fire-alarm cables, NFPA 70, Types MI and CI, is not permitted.
  4. Signaling Line Circuits: Power-limited fire-alarm cables must not be installed in the same cable or pathway as signaling line circuits.
- C. 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 fire-alarm system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes; cabinets; or equipment enclosures where circuit connections are made.
- 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 CONNECTIONS
- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
  - B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
  - C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inch (150 mm) slack.
  - D. Comply with requirements in Section 284621.11 "Addressable Fire-Alarm Systems" for connecting, terminating, and identifying wires and cables.

3.6 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.7 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.8 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.9 FIELD QUALITY CONTROL

- A. Tests and Inspections:
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors, including generator and ATS feeders for compliance with requirements.
  - 2. Perform each of the following visual and electrical tests:
    - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
    - b. Test bolted connections for high resistance using one of the following:
      - 1) A low-resistance ohmmeter.
      - 2) Calibrated torque wrench.
      - 3) Thermographic survey.
    - c. Inspect compression-applied connectors for correct cable match and indentation.
    - d. Inspect for correct identification.
    - e. Inspect cable jacket and condition.
    - f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500 V(dc) for 300 V rated cable and 1000 V(dc) for 600 V rated cable for a one-minute duration.
    - g. Continuity test on each conductor and cable.
    - h. Uniform resistance of parallel conductors.

3. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each termination or splice in conductors No. 3 AWG and larger. Remove box and equipment covers so connections are accessible to portable scanner. Correct deficiencies determined during the scan.
    - a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
    - b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
  4. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each same connection 11 months after date of Substantial Completion.
- B. Cables will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports to record the following:
1. Procedures used.
  2. Results that comply with requirements.
  3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

## SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Grounding and bonding conductors.
2. Grounding and bonding clamps.
3. Grounding and bonding bushings.
4. Grounding and bonding hubs.
5. Grounding and bonding connectors.
6. Intersystem bonding bridge grounding connector.
7. Grounding and bonding busbars.
8. Grounding (earthing) electrodes.
9. Grounding electrode enclosures.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" specifies additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" specifies seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Plans showing dimensioned locations of grounding features described in "Field Quality Control for Grounding and Bonding of Electrical Power" Article, including the following:

1. Grounding electrode access enclosures.
2. Grounding electrodes.
3. Grounding arrangements and connections for separately derived systems.

C. Field quality-control reports.

#### 1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. In addition to items specified in Section 260010 "Supplemental Requirements for Electrical," include the following:

- a. Plans showing locations of grounding features described in "Field Quality Control for Grounding and Bonding of Electrical Power" Article, including the following:
  - 1) Grounding electrode access enclosures.
  - 2) Grounding electrodes.
  - 3) Grounding arrangements and connections for separately derived systems.

## PART 2 - PRODUCTS

### 2.1 GROUNDING AND BONDING CONDUCTORS

#### A. Equipment Grounding Conductor:

1. General Characteristics: 600 V, **THHN/THWN-2 copper** wire or cable, green color, in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

#### B. ASTM - Bare Copper Grounding and Bonding Conductor:

1. Referenced Standards: Complying with one or more of the following:
  - a. Soft or Annealed Copper Wire: ASTM B3.
  - b. Concentric-Lay Stranded Copper Conductor: ASTM B8.
  - c. Tin-Coated Soft or Annealed Copper Wire: ASTM B33.
  - d. 19-Wire Combination Unilay-Stranded Copper Conductor: ASTM B787/B787M.

### 2.2 GROUNDING AND BONDING CLAMPS

#### A. Description: Clamps suitable for attachment of grounding and bonding conductors to grounding electrodes, pipes, tubing, and rebar. Grounding and bonding clamps specified in this article are also suitable for use with communications applications.

#### B. Source Limitations: Obtain products from single manufacturer.

#### C. Performance Criteria:

1. Regulatory Requirements:
  - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria:
  - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

#### D. UL KDER and KDSH - Hex-Fitting-Type Pipe and Rod Grounding and Bonding Clamp:

1. General Characteristics:

- a. Two pieces with stainless steel bolts.
  - b. Clamp Material: Silicon bronze or Brass.
  - c. Listed for outdoor use.
- E. UL KDER and KDSH - U-Bolt-Type Pipe and Rod Grounding and Bonding Clamp:
  - 1. General Characteristics:
    - a. Clamp Material: Brass.
    - b. Listed for outdoor use.
- F. UL KDER and KDSH - Strap-Type Pipe and Rod Grounding and Bonding Clamp:
  - 1. General Characteristics:
    - a. Clamp Material: Copper.
    - b. Listed for outdoor use.
- G. UL KDER - Beam Grounding and Bonding Clamp:
  - 1. General Characteristics: Mechanical-type, terminal, ground wire access from four directions; with dual, tin-plated or silicon bronze bolts.
- H. UL KDER - Exothermically Welded Connection:
  - 1. General Characteristics: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

## 2.3 GROUNDING AND BONDING BUSHINGS

- A. Description: Bonding bushings connect conduit fittings, tubing fittings, threaded metal conduit, and unthreaded metal conduit to metal boxes and equipment enclosures, and have one or more bonding screws intended to provide electrical continuity between bushing and enclosure. Grounding bushings have provision for connection of bonding or grounding conductor and may or may not also have bonding screws.
- B. Source Limitations: Obtain products from single manufacturer.
- C. Performance Criteria:
  - 1. Regulatory Requirements:
    - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
  - 2. Listing Criteria:
    - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
- D. UL KDER - Bonding Bushing:

1. General Characteristics: Threaded bushing with insulated throat.

E. UL KDER - Grounding Bushing:

1. General Characteristics: Threaded bushing with insulated throat and mechanical-type wire terminal.

2.4 GROUNDING AND BONDING HUBS

- A. Description: Hubs with certified grounding or bonding locknut.

- B. Source Limitations: Obtain products from single manufacturer.

- C. Performance Criteria:

1. Regulatory Requirements:

- a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. Listing Criteria:

- a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

- D. UL KDER - Grounding and Bonding Hub:

1. General Characteristics: Insulated, gasketed, watertight hub with mechanical-type wire terminal.

2.5 GROUNDING AND BONDING CONNECTORS

- A. Source Limitations: Obtain products from single manufacturer.

- B. Performance Criteria:

1. Regulatory Requirements:

- a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. Listing Criteria:

- a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
- b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.

- C. UL KDER - Pressure-Type Grounding and Bonding Busbar Cable Connector:



1. General Characteristics: Copper or copper alloy, for compression bonding of one or more conductor directly to copper busbar. Listed for direct burial.
- D. UL KDER - Lay-In Lug Mechanical-Type Grounding and Bonding Busbar Terminal:
  1. General Characteristics: Mechanical-type, copper rated for direct burial terminal with set screw.
- E. UL KDER - Crimped Lug Pressure-Type Grounding and Bonding Busbar Terminal:
  1. General Characteristics: Cast silicon bronze, solderless compression-type wire terminals; with long barrel and two holes spaced on 5/8 or 1 inch (16 or 25 mm) centers for two-bolt connection to busbar.
- F. UL KDER - Split-Bolt Service-Post Pressure-Type Grounding and Bonding Busbar Terminal:
  1. General Characteristics: Bolts that surround cable and bond to cable under compression when nut is tightened after assembly is screwed into busbar opening.
- G. UL KDER - Crimped Pressure-Type Grounding and Bonding Cable Connector:
  1. General Characteristics: Crimp-and-compress connectors that bond to conductor when connector is compressed around conductor.
    - a. Copper, C and H shaped.
- H. UL KDER - Split-Bolt Pressure-Type Grounding and Bonding Cable Connector:
  1. General Characteristics: Bolts that surround cable and bond to cable under compression when nut is tightened.
    - a. Copper.

## 2.6 GROUNDING AND BONDING BUSBARS

- A. Description: Miscellaneous grounding and bonding devices that serve as common connection for multiple grounding and bonding conductors.
- B. Performance Criteria:
  1. Regulatory Requirements:
    - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
  2. Listing Criteria:
    - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
- C. UL KDER - Equipment Room Grounding and Bonding Busbar:

1. General Characteristics:
  - a. Bus: Rectangular bar of annealed copper.
  - b. Mounting Stand-Off Insulators: Lexan or PVC.
2. Options:
  - a. Dimensions: 1/4 by 4 inch (6.3 by 100 mm) in cross section.

## 2.7 GROUNDING (EARTHING) ELECTRODES

- A. Source Limitations: Obtain products from single manufacturer.
- B. Performance Criteria:
  1. Regulatory Requirements:
    - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
  2. Listing Criteria:
    - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
- C. UL KDER - Rod Electrode:
  1. General Characteristics: Copper-clad steel; 3/4 inch by 10 ft.

## 2.8 GROUNDING ELECTRODE ENCLOSURES

- A. Description: Enclosures designed to protect grounding electrodes from damage while providing access for inspection and testing of the grounding system.
- B. Grounding Electrode Access Well Enclosure:
  1. Source Limitations: Obtain products from single manufacturer.
  2. Product Characteristics:
    - a. Well Material: HDPE or Schedule 40 PVC.
    - b. Cover Material: Plastic.
    - c. Cover Strength: Sidewalk or turf use.
  3. Required Product Options:
    - a. Round:
      - 1) Slotted sides for installation after grounding connections made.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine facility's grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of electrical system.
- B. Inspect test results of grounding system measured at point of electrical service equipment connection.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with connection of electrical service equipment only after unsatisfactory conditions have been corrected.

### 3.2 SELECTION OF GROUNDING AND BONDING PRODUCTS

- A. Grounding and Bonding Conductors:
  - 1. Provide solid conductor for 8 AWG and smaller, and stranded conductors for 6 AWG and larger unless otherwise indicated.
  - 2. Custom-Length Insulated Equipment Bonding Jumpers: 6 AWG, 19-strand, Type THHN.
  - 3. Bonding Cable: 28 kcmil, 14 strands of 17 AWG conductor, 1/4 inch (6 mm) in diameter.
  - 4. Bonding Conductor: 4 AWG or 6 AWG, stranded conductor.
  - 5. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch (41 mm) wide and 1/16 inch (1.6 mm) thick.
  - 6. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch (41 mm) wide and 1/16 inch (1.6 mm) thick.
  - 7. Underground Grounding Conductors: Install bare copper conductor, 2/0 AWG minimum.
- B. Grounding and Bonding Connectors:
  - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
  - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
  - 4. Connections to Structural Steel: Welded connectors.
- C. Grounding and Bonding Busbars: Provide in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated on Drawings.

### 3.3 INSTALLATION OF GROUNDING AND BONDING

- A. Comply with manufacturer's published instructions.
- B. Reference Standards:

1. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
  2. Consult Architect for resolution of conflicting requirements.
- C. Special Techniques:
1. Grounding and Bonding Conductors:
    - a. Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
    - b. Underground Grounding Conductors:
      - 1) Bury at least 30 inch below grade.
      - 2) Duct-Bank Grounding Conductor: Bury 12 inch (300 mm) above duct bank when indicated as part of duct-bank installation.
  2. Grounding and Bonding Connectors: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
    - a. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
    - b. Make connections with clean, bare metal at points of contact.
    - c. Make aluminum-to-steel connections with stainless steel separators and mechanical clamps.
    - d. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
    - e. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
    - f. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
      - 1) Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate adjacent parts.
      - 2) Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
      - 3) Use exothermic-welded connectors for outdoor locations; if disconnect-type connection is required, use bolted clamp.
    - g. Grounding and Bonding for Piping:
      - 1) Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use bolted clamp connector or bolt lug-type connector to pipe flange by using one of lug bolts of flange. Where

- dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
- 2) Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with bolted connector.
  - 3) Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- h. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.
  - i. Grounding for Steel Building Structure: Install driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 ft (18 m) apart.
3. Grounding and Bonding Busbars:
    - a. Install busbar horizontally, on insulated spacers 2 inch (50 mm) minimum from wall, 6 inch (150 mm) above finished floor unless otherwise indicated.
    - b. Where busbars are indicated on both sides of doorways, route bonding conductor up to top of door frame, across top of doorway, and down; connect to continuation of horizontal busbar.
  4. Electrodes:
    - a. Ground Rods: Drive rods until tops are 2 inch (50 mm) below finished floor or final grade unless otherwise indicated.
      - 1) Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
      - 2) Use exothermic welds for below-grade connections.
    - b. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least same distance from other grounding electrodes, and connect to service grounding electrode conductor.
    - c. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems," and must be at least 12 inch (300 mm) deep, with cover.
      - 1) Install at least one test well for each service unless otherwise indicated. Install at ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
  5. Grounding at Service:
    - a. Equipment grounding conductors and grounding electrode conductors must be connected to ground busbar. Install main bonding jumper between neutral and ground buses.
  6. Grounding Separately Derived Systems:

- a. Permanent Generators: Install grounding electrode(s) at location of permanent generators having switched neutral connections. Electrode must be connected to equipment grounding conductor and to frame of generator.

7. Grounding Underground Distribution System Components:

- a. Duct-Bank Grounding Conductor: Bury 12 inch (300 mm) above duct bank when indicated as part of duct-bank installation.
- b. Comply with IEEE C2 grounding requirements.
- c. Grounding Manholes and Handholes: Install driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inch (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inch (50 mm) above to 6 inch (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.
- d. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields in accordance with manufacturer's published instructions with splicing and termination kits.
- e. Pad-Mounted Transformers and Switches: Install two ground rods and ring electrode around pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than 2 AWG for ring electrode and for taps to equipment grounding terminals. Bury ring electrode not less than 6 inch (150 mm) from foundation.

8. Equipment Grounding and Bonding:

- a. Install insulated equipment grounding conductors with all feeders and branch circuits.

3.4 FIELD QUALITY CONTROL FOR GROUNDING AND BONDING

A. Tests and Inspections:

- 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
- 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with calibrated torque wrench in accordance with manufacturer's published instructions.
- 3. Test completed grounding system at each location where maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before conductors are connected.

- a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    - b. Perform tests by fall-of-potential method in accordance with IEEE Std 81.
    - c. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.
  4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to record of tests and observations. Include number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- B. Nonconforming Work:
1. Grounding system will be considered defective if it does not pass tests and inspections.
  2. Remove and replace defective components and retest.
- C. Collect, assemble, and submit test and inspection reports.
1. Report measured ground resistances that exceed the following values:
    - a. Power and Lighting Equipment or System with Capacity of 1000 kVA and Less: 5  $\Omega$ .

### 3.5 PROTECTION

- A. After installation, protect grounding and bonding cables and equipment from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 260526

## SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Support, anchorage, and attachment components.
2. Fabricated metal equipment support assemblies.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

#### 1.2 ACTION SUBMITTALS

A. Product Data:

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
  - a. Slotted support systems, hardware, and accessories.
  - b. Clamps.
  - c. Hangers.
  - d. Sockets.
  - e. Eye nuts.
  - f. Fasteners.
  - g. Anchors.
  - h. Saddles.
  - i. Brackets.
2. Include rated capacities and furnished specialties and accessories.

B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.

1. Hangers. Include product data for components.
2. Slotted support systems.
3. Equipment supports.



4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
- C. Delegated Design Submittals: For hangers and supports for electrical systems.
1. Include design calculations and details of hangers.
  2. Include design calculations for seismic restraints.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified structural professional engineer to design hanger and support system.

### 2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32 inch (10 mm) diameter holes at a maximum of 8 inch (200 mm) on center in at least one surface.
1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
  2. Material for Channel, Fittings, and Accessories: Galvanized steel.
  3. Channel Width: Selected for applicable load criteria.
  4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
- B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs must have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body must be made of malleable iron.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
  2. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.

3. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325 (Grade A325M).
5. Toggle Bolts: Stainless steel springhead type.
6. Hanger Rods: Threaded steel.

## 2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

## PART 3 - EXECUTION

### 3.1 SELECTION

- A. Comply with the following standards for selection and installation of hangers and supports, except where requirements on Drawings or in this Section are stricter:
  1. NECA NEIS 101
- B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- C. Comply with requirements for raceways specified in Section 260533.13 "Conduits for Electrical Systems."
- D. Comply with requirements for boxes specified in Section 260533.16 "Boxes and Covers for Electrical Systems."
- E. Provide vibration and seismic controls with hangers and supports in accordance with requirements specified in "Section 260548 "Vibration and Seismic Controls for Electrical Systems.
- F. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and ERM as scheduled in NECA NEIS 1, where its Table 1 lists maximum spacings that are less than those stated in NFPA 70. Minimum rod size must be 1/4 inch (6 mm) in diameter.
- G. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
  1. Secure raceways and cables to these supports with two-bolt conduit clamps.

### 3.2 INSTALLATION OF SUPPORTS

- A. Comply with NECA NEIS 101 for installation requirements except as specified in this article.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination must be weight of supported components plus 200 lb (90 kg).
- C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
  - 1. To Wood: Fasten with lag screws or through bolts.
  - 2. To New Concrete: Bolt to concrete inserts.
  - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  - 4. To Existing Concrete: Expansion anchor fasteners.
  - 5. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts or Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69. Means shall comply with seismic-restraint strength and anchorage requirements
  - 6. To Light Steel: Sheet metal screws.
  - 7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.
- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

### 3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

### 3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inch (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000 psi (min.), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base as follows:

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

### 3.5 PAINTING

#### A. Touchup:

1. Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
2. Comply with requirements in Division 09 for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

#### B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION 260529

## SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Support, anchorage, and attachment components.
2. Fabricated metal equipment support assemblies.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

#### 1.2 ACTION SUBMITTALS

A. Product Data:

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
  - a. Slotted support systems, hardware, and accessories.
  - b. Clamps.
  - c. Hangers.
  - d. Sockets.
  - e. Eye nuts.
  - f. Fasteners.
  - g. Anchors.
  - h. Saddles.
  - i. Brackets.
2. Include rated capacities and furnished specialties and accessories.

B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.

1. Hangers. Include product data for components.
2. Slotted support systems.
3. Equipment supports.
4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated Design Submittals: For hangers and supports for electrical systems.

1. Include design calculations and details of hangers.
2. Include design calculations for seismic restraints.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified structural professional engineer to design hanger and support system.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32 inch (10 mm) diameter holes at a maximum of 8 inch (200 mm) on center in at least one surface.
1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
  2. Material for Channel, Fittings, and Accessories: Galvanized steel.
  3. Channel Width: Selected for applicable load criteria.
  4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
- B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs must have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body must be made of malleable iron.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
  2. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
  3. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
  4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325 (Grade A325M).
  5. Toggle Bolts: Stainless steel springhead type.
  6. Hanger Rods: Threaded steel.

## 2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

## PART 3 - EXECUTION

### 3.1 SELECTION

- A. Comply with the following standards for selection and installation of hangers and supports, except where requirements on Drawings or in this Section are stricter:
  - 1. NECA NEIS 101
- B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- C. Comply with requirements for raceways specified in Section 260533.13 "Conduits for Electrical Systems."
- D. Comply with requirements for boxes specified in Section 260533.16 "Boxes and Covers for Electrical Systems."
- E. Provide vibration and seismic controls with hangers and supports in accordance with requirements specified in "Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- F. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and ERM as scheduled in NECA NEIS 1, where its Table 1 lists maximum spacings that are less than those stated in NFPA 70. Minimum rod size must be 1/4 inch (6 mm) in diameter.
- G. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
  - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.

### 3.2 INSTALLATION OF SUPPORTS

- A. Comply with NECA NEIS 101 for installation requirements except as specified in this article.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination must be weight of supported components plus 200 lb (90 kg).

- C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
1. To Wood: Fasten with lag screws or through bolts.
  2. To New Concrete: Bolt to concrete inserts.
  3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  4. To Existing Concrete: Expansion anchor fasteners.
  5. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts or Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69. Means shall comply with seismic-restraint strength and anchorage requirements
  6. To Light Steel: Sheet metal screws.
  7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.
- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

### 3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

### 3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inch (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000 psi (min.), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base as follows:
1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  2. Install anchor bolts to elevations required for proper attachment to supported equipment.
  3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.



3.5 PAINTING

A. Touchup:

1. Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
2. Comply with requirements in Division 09 for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION 260529

## SECTION 260533.13 - CONDUITS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Type EMT-S duct raceways and elbows.
2. Type ERM-C-S duct raceways, elbows, couplings, and nipples.
3. Type LFMC duct raceways.
4. Type PVC duct raceways and fittings.
5. Fittings for conduit, tubing, and cable.
6. Electrically conductive corrosion-resistant compounds for threaded conduit.
7. Solvent cements.

##### B. Products Installed, but Not Furnished, under This Section:

1. See Section 260553 "Identification for Electrical Systems" for electrical equipment labels.

##### C. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
3. Section 260519 "Low-Voltage for Electrical Power Conductors and Cables" for nonmetallic underground conduit with conductors (Type NUCC).
4. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior duct banks, manholes, and underground utility construction.

#### 1.2 DEFINITIONS

- A. Conduit: A structure containing one or more duct raceways.
- B. Duct Raceway: A single enclosed raceway for conductors or cable.
- C. Duct Bank: An arrangement of conduit providing one or more continuous duct raceways between two points.

#### 1.3 ACTION SUBMITTALS

##### A. Product Data:

1. Type EMT-S duct raceways and elbows.

2. Type ERMCS duct raceways, elbows, couplings, and nipples.
3. Type LFMC duct raceways.
4. Type LFNC duct raceways.
5. Type PVC duct raceways and fittings.
6. Fittings for conduit, tubing, and cable.
7. Electrically conductive corrosion-resistant compounds for threaded conduit.
8. Solvent cements.

## PART 2 - PRODUCTS

### 2.1 TYPE EMT-S DUCT RACEWAYS AND ELBOWS

#### A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN FJMX; including UL 797.

#### B. UL FJMX - Steel Electrical Metal Tubing (EMT-S) and Elbows:

1. Material: Steel.
2. Options:
  - a. Exterior Coating: Zinc.
  - b. Interior Coating: Zinc.
  - c. Minimum Trade Size: trade size 3/4.

### 2.2 TYPE ERMCS DUCT RACEWAYS, ELBOWS, COUPLINGS, AND NIPPLES

#### A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN DYIX; including UL 6.

#### B. UL DYIX - Galvanized-Steel Electrical Rigid Metal Conduit (ERMC-S-G), Elbows, Couplings, and Nipples:

1. Exterior Coating: Zinc.
2. Options:
  - a. Interior Coating: Zinc with organic top coating.
  - b. Minimum Trade Size: trade size 3/4.

## 2.3 TYPE LFMC DUCT RACEWAYS

### A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN DXHR; including UL 360.

### B. UL DXHR - Steel Liquidtight Flexible Metal Conduit (LFMC-S):

1. Material: Steel.
2. Options:
  - a. Minimum Trade Size: trade size 3/4.

## 2.4 TYPE PVC DUCT RACEWAYS AND FITTINGS

### A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN DZYR; including UL 651.

### B. UL DZYR - Schedule 40 Rigid PVC Conduit (PVC-40) and Fittings:

1. Dimensional Specifications: Schedule 40.
2. Options:
  - a. Minimum Trade Size: trade size 3/4.
  - b. Markings: For use with maximum 90 deg C wire.

## 2.5 FITTINGS FOR CONDUIT, TUBING, AND CABLE

### A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

### B. UL DWTT - Fittings for Type ERM C Duct Raceways:

1. Listing Criteria: UL CCN DWTT; including UL 514B.
2. Options:
  - a. Material: Steel.
  - b. Coupling Method: threaded.
  - c. Expansion and Deflection Fittings: UL 651 with flexible bonding jumper.

C. UL FKAV - Fittings for Type EMT Duct Raceways:

1. Listing Criteria: UL CCN FKAV; including UL 514B.
2. Options:
  - a. Material: Steel.
  - b. Coupling Method: Compression coupling.
  - c. Expansion and Deflection Fittings: UL 651 with flexible bonding jumper.

D. UL DXAS - Fittings for Type LFMC and Type LFNC Duct Raceways:

1. Listing Criteria: UL CCN DXAS; including UL 514B.

2.6 ELECTRICALLY CONDUCTIVE CORROSION-RESISTANT COMPOUNDS FOR THREADED CONDUIT

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN FOIZ; including UL Subject 2419.

2.7 SOLVENT CEMENTS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN DWTT; including UL 514B.

PART 3 - EXECUTION

3.1 SELECTION OF CONDUITS FOR ELECTRICAL SYSTEMS

- A. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NFPA 70 for selection of duct raceways. Consult Architect for resolution of conflicting requirements.
- B. Outdoors:
  1. Exposed and Subject to Severe Physical Damage: ERM C.
  2. Exposed and Subject to Physical Damage: ERM C.
    - a. Locations less than 2.5 m (8 ft) above finished floor.
  3. Exposed and Not Subject to Physical Damage: ERM C.

4. Concealed Aboveground: ERM C.
5. Direct Buried: PVC-40.
6. Concrete Encased: PVC-40.
7. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

C. Indoors:

1. Exposed and Subject to Severe Physical Damage: ERM C. Locations include the following:
  - a. Garages.
  - b. Mechanical rooms.
2. Exposed and Subject to Physical Damage: EMT. Locations include the following:
  - a. Locations less than 2.5 m (8 ft) above finished floor.
  - b. Stub-ups to above suspended ceilings.
3. Exposed and Not Subject to Physical Damage: EMT.
4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Damp or Wet Locations: ERM C.
6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

D. Duct Fittings: Select fittings in accordance with NEMA FB 2.10 guidelines.

1. ERM C: Provide threaded-type fittings unless otherwise indicated.

3.2 INSTALLATION OF CONDUITS FOR ELECTRICAL SYSTEMS

A. Comply with manufacturer's published instructions.

B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:

1. Type EMT-S: Article 358 of NFPA 70 and NECA NEIS 101.
2. Type ERM C-S: Article 344 of NFPA 70 and NECA NEIS 101.
3. Type LFMC: Article 350 of NFPA 70 and NECA NEIS 101.
4. Type PVC: Article 356 of NFPA 70 and NECA NEIS 111.
5. Expansion Fittings: NEMA FB 2.40.
6. Consult Architect for resolution of conflicting requirements.

C. Special Installation Techniques:

1. General Requirements for Installation of Duct Raceways:
  - a. Complete duct raceway installation before starting conductor installation.

- b. Provide stub-ups through floors with coupling threaded inside for plugs, set flush with finished floor. Plug coupling until conduit is extended above floor to final destination or a minimum of 2 ft (0.6 m) above finished floor.
- c. Install no more than equivalent of three 90-degree bends in conduit run. Support within 12 inch (300 mm) of changes in direction.
- d. Make bends in duct raceway using large-radius preformed ells except for parallel bends. Field bending must be in accordance with NFPA 70 minimum radii requirements. Provide only equipment specifically designed for material and size involved.
- e. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- f. Support conduit within 12 inch (300 mm) of enclosures to which attached.
- g. Install duct sealing fittings at accessible locations in accordance with NFPA 70 and fill them with listed sealing compound. For concealed duct raceways, install fitting in flush steel box with blank cover plate having finish similar to that of adjacent plates or surfaces. Install duct sealing fittings in accordance with NFPA 70.
- h. Install devices to seal duct raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal interior of duct raceways at the following points:
  - 1) Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  - 2) Where an underground service duct raceway enters a building or structure.
  - 3) Conduit extending from interior to exterior of building.
  - 4) Conduit extending into pressurized duct raceway and equipment.
  - 5) Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
  - 6) Where otherwise required by NFPA 70.
- i. Do not install conduits within 2 inch (50 mm) of the bottom side of a metal deck roof.
- j. Keep duct raceways at least 6 inch (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal duct raceway runs above water and steam piping.
- k. Cut conduit perpendicular to the length. For conduits metric designator 53 (trade size 2) and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. Ream inside of conduit to remove burrs.
- l. Install pull wires in empty duct raceways. Provide polypropylene or monofilament plastic line with not less than 200 lb (90 kg) tensile strength. Leave at least 12 inch (300 mm) of slack at both ends of pull wire. Cap underground duct raceways designated as spare above grade alongside duct raceways in use.
- m. Install duct raceways square to the enclosure and terminate at enclosures without hubs with locknuts on both sides of enclosure wall. Install locknuts hand tight, plus one-quarter turn more.
  - 1) Termination fittings with shoulders do not require two locknuts.
- n. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to metric designator 35 (trade size 1-1/4) and insulated throat metal bushings on metric

designator 41 (trade size 1-1/2) and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

2. Types ERMCM:
  - a. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound that maintains electrical conductivity to threads of duct raceway and fittings before making up joints. Follow compound manufacturer's published instructions.
3. Types FMC, LFMC, and LFNC:
  - a. Provide a maximum of 36 inch of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
4. Types PVC:
  - a. Do not install Type PVC conduit where ambient temperature exceeds 122 deg F. Conductor ratings must be limited to 75 deg C except where installed in a trench outside buildings with concrete encasement, where 90 deg C conductors are permitted.
  - b. Comply with manufacturer's published instructions for solvent welding and fittings.
  - c. Arrange duct raceways to cross building expansion joints with expansion fittings at right angles to the joint.
  - d. Arrange duct raceways to ensure that each is surrounded by minimum of 2 inch of concrete without voids.
  - e. Do not embed threadless fittings in concrete unless locations have been specifically approved by Architect.
5. Stub-ups to Above Recessed Ceilings:
  - a. Provide EMT or ERMCM for duct raceways.
  - b. Provide a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
6. Duct Raceway Terminations at Locations Subject to Moisture or Vibration:
  - a. Provide insulating bushings to protect conductors, including conductors smaller than 4 AWG.
7. Duct Fittings: Install fittings in accordance with NEMA FB 2.10 guidelines.
  - a. EMT: Provide compression steel fittings. Comply with NEMA FB 2.10.
  - b. Flexible Conduit: Provide only fittings listed for use with flexible conduit type. Comply with NEMA FB 2.20.
8. Expansion-Joint Fittings:
  - a. Install type and quantity of fittings that accommodate temperature change listed for the following locations:



- 1) Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
  - 2) Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
  - 3) Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
- b. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.
  - c. Install expansion fittings at locations where conduits cross building or structure expansion joints.
  - d. Install expansion-joint fitting with position, mounting, and piston setting selected in accordance with manufacturer's published instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
9. Duct Raceways Penetrating Rooms or Walls with Acoustical Requirements: Seal duct raceway openings on both sides of rooms or walls with acoustically rated putty or firestopping.

D. Interfaces with Other Work:

1. Coordinate with Section 078413 "Penetration Firestopping" for installation of firestopping at penetrations of fire-rated floor and wall assemblies.
2. Coordinate with Section 260529 "Hangers and Supports for Electrical Systems" for installation of conduit hangers and supports.

### 3.3 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533.13

## SECTION 260533.16 - BOXES AND COVERS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Metallic outlet boxes, device boxes, rings, and covers.
2. Nonmetallic outlet boxes, device boxes, rings, and covers.
3. Junction boxes and pull boxes.
4. Cover plates for device boxes.
5. Hoods for outlet boxes.

##### B. Products Installed, but Not Furnished, under This Section:

1. See Section 260553 "Identification for Electrical Systems" for electrical equipment labels.

##### C. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

#### 1.2 ACTION SUBMITTALS

##### A. Product Data:

1. Metallic outlet boxes, device boxes, rings, and covers.
2. Nonmetallic outlet boxes, device boxes, rings, and covers.
3. Junction boxes and pull boxes.
4. Cover plates for device boxes.
5. Hoods for outlet boxes.

### PART 2 - PRODUCTS

#### 2.1 METALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

##### A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN QCIT; including UL 514A.

B. UL QCIT - Metallic Outlet Boxes and Covers:

1. Description: Box having pryout openings, knockouts, threaded entries, or hubs in either the sides of the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.
2. Options:
  - a. Material: Sheet steel or Cast metal.
  - b. Sheet Metal Depth: Minimum 1.5 inch (38 mm).
  - c. Cast-Metal Depth: Minimum 1.8 inch (44.5 mm).
  - d. Luminaire Outlet Boxes and Covers: Nonadjustable, listed and labeled for attachment of luminaire weighing up to 50 lb and marked with maximum allowable weight.

C. UL QCIT - Metallic Conduit Bodies:

1. Description: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.

D. UL QCIT - Metallic Device Boxes:

1. Description: Box with provisions for mounting wiring device directly to box.
2. Options:
  - a. Material: sheet steel or Cast metal.
  - b. Sheet Metal Depth: minimum 1.5 inch.
  - c. Cast-Metal Depth: minimum 1.8 inch.

E. UL QCIT - Metallic Extension Rings:

1. Description: Ring intended to extend sides of outlet box or device box to increase box depth, volume, or both.

F. UL QCIT - Metallic Floor Boxes and Floor Box Covers:

1. Description: Box mounted in floor with floor box cover and other components to complete floor box enclosure.

G. UL QCIT - Metallic Concrete Boxes and Covers:

1. Description: Box intended for use in poured concrete.

## 2.2 NONMETALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

### A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. Listing Criteria: UL CCN QCMZ; including UL 514C.

### B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

### C. UL QCMZ - Nonmetallic Outlet Boxes and Covers:

1. Description: Box having pryout openings, knockouts, threaded entries, or hubs in either the sides or the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.

### D. UL QCMZ - Nonmetallic Conduit Bodies:

1. Description: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.

### E. UL QCMZ - Nonmetallic Device Boxes:

1. Description: Box with provisions for mounting wiring device directly to box.

### F. UL QCMZ - Nonmetallic Extension Rings:

1. Description: Ring intended to extend sides of outlet box or device box to increase box depth, volume, or both.

### G. UL QCMZ - Nonmetallic Floor Boxes and Floor Box Covers:

1. Description: Box mounted in floor with floor box cover and other components to complete floor box enclosure.

## 2.3 JUNCTION BOXES AND PULL BOXES

### A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. Listing Criteria: UL CCN BGUZ; including UL 50 and UL 50E.

### B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

C. UL BGUZ - Indoor Sheet Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Options:
  - a. Degree of Protection: Type 1.

D. UL BGUZ - Outdoor Sheet Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Options:
  - a. Degree of Protection: Type 3R.

E. UL BGUZ - Outdoor Cast-Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Options:
  - a. Degree of Protection: Type 4 or Type 4X.

## 2.4 COVER PLATES FOR DEVICES BOXES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. Listing Criteria: UL CCN QCIT or UL CCN QCMZ; including UL 514D.
3. Wallplate-Securing Screws: Metal with head color to match wallplate finish.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

C. UL QCIT or QCMZ - Metallic Cover Plates for Device Boxes:

1. Options:
  - a. Damp and Wet Locations: Listed, labeled, and marked for location and use. Provide gaskets and accessories necessary for compliance with listing.
  - b. Wallplate Material; Office area: Steel with white baked enamel, suitable for field painting.

- c. Wallplate Material; Garage and Utility Areas: 0.032 inch thick, Type 302/304 non-magnetic stainless steel with brushed finish.

## 2.5 HOODS FOR OUTLET BOXES

### A. Performance Criteria:

- 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
- 2. Listing Criteria:
  - a. UL CCN QCIT or UL CCN QCMZ; including UL 514D.
  - b. Receptacle, Hood, Cover Plate, Gaskets, and Seals: UL 498 Supplement SA when mated with box or enclosure complying with UL 514A, UL 514C, or UL 50E.
- 3. Mounts to box using fasteners different from wiring device.

### B. Source Quality Control:

- 1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

### C. UL QCIT or QCMZ - Extra-Duty, While-in-Use Hoods for Outlet Boxes:

- 1. Additional Characteristics: Marked "Extra-Duty" in accordance with UL 514D.
- 2. Options:
  - a. Provides gray, weatherproof, "while-in-use" cover.
  - b. Manufacturer may combine nonmetallic device box with hood as extra-duty rated assembly.

## PART 3 - EXECUTION

### 3.1 SELECTION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

- A. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NFPA 70 for selection of boxes and enclosures. Consult Architect for resolution of conflicting requirements.

### B. Degree of Protection:

- 1. Outdoors:
  - a. Type 3R unless otherwise indicated.
  - b. Locations Exposed to Hosedown: Type 4X.
  - c. Locations Aboveground Where Mechanism Must Operate When Ice Covered: Type 3S.
  - d. Locations in-Ground or Exposed to Corrosive Agents: Type 4X.

- e. Locations in-Ground or Exposed to Corrosive Agents Where Mechanism Must Operate When Ice Covered: Type 3SX.
  - 2. Indoors:
    - a. Type 1 unless otherwise indicated.
    - b. Damp or Dusty Locations: Type 12.
    - c. Kitchens and Other Locations Exposed to Oil or Coolants: Type 12.
    - d. Locations Exposed to Airborne Dust, Lint, Fibers, or Flyings: Type 4.
    - e. Locations Exposed to Hosedown: Type 4X.
    - f. Locations Exposed to Corrosive Agents: Type 4X.
    - g. Locations Exposed to Spraying Oil or Coolants: Type 13.
  - C. Exposed Boxes Installed Less Than 2.5 m (8 ft) Above Floor:
    - 1. Provide cast-metal boxes.
    - 2. Provide exposed cover. Flat covers with angled mounting slots or knockouts are prohibited.
- 3.2 INSTALLATION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS
- A. Comply with manufacturer's published instructions.
  - B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:
    - 1. Outlet, Device, Pull, and Junction Boxes: Article 314 of NFPA 70.
    - 2. Consult Architect for resolution of conflicting requirements.
  - C. Special Installation Techniques:
    - 1. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.
    - 2. 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.
    - 3. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box, whether installed indoors or outdoors.
    - 4. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
    - 5. Locate boxes so that cover or plate will not span different building finishes.
    - 6. Support boxes in recessed ceilings independent of ceiling tiles and ceiling grid.
    - 7. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for purpose.
    - 8. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.
    - 9. Set metal floor boxes level and flush with finished floor surface.

10. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
11. Do not install aluminum boxes, enclosures, or fittings in contact with concrete or earth.
12. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to ensure a continuous ground path.
13. Boxes and Enclosures in Areas or Walls with Acoustical Requirements:
  - a. Seal openings and knockouts in back and sides of boxes and enclosures with acoustically rated putty.
  - b. Provide gaskets for wallplates and covers.
14. Identification: Provide labels for boxes and associated electrical equipment.
  - a. Identify field-installed conductors, interconnecting wiring, and components.
  - b. Provide warning signs.
  - c. Label each box with engraved metal or laminated-plastic nameplate.
15. Coordinate with Section 260573.13 "Short-Circuit Studies" for determining available fault current on input feeder.
16. Coordinate with Section 260573.19 "Arc-Flash Hazard Analysis" for determining arc-flash hazard on input feeder.

### 3.3 CLEANING

- A. Remove construction dust and debris from boxes before installing wallplates, covers, and hoods.

### 3.4 PROTECTION

- A. After installation, protect boxes from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 260533.16



## SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Type PVC raceways and fittings.
2. Fittings for conduit, tubing, and cable.
3. Solvent cements.
4. Duct accessories.
5. Handholes and boxes for exterior underground wiring.
6. Manholes for exterior underground wiring.
7. Utility structure accessories.
8. Duct sealing.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" specifies additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" specifies seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
3. Section 260519 "Low-Voltage for Electrical Power Conductors and Cables" specifies nonmetallic underground conduit with conductors (Type NUCC).
4. Section 260553 "Identification for Electrical Systems" specifies underground-line warning tape and concrete cable routing markers (warning planks).

#### 1.2 DEFINITIONS

- A. Duct: A single raceway or multiple raceways, installed singly or as components of a duct bank.
- B. Duct Bank: Two or more ducts installed in parallel, direct buried or with additional casing materials such as concrete.
- C. Handhole: An underground chamber containing electrical cables, sized such that personnel are not required to enter in order to access the cables.
- D. Manhole: An underground chamber containing electrical cables and equipment, sized to provide access with working space clearances.
- E. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For concrete and steel used in precast concrete manholes and handholes, also include product certificates as required by ASTM C858.

B. Shop Drawings:

1. Precast or Factory-Fabricated Concrete Structures:

- a. Include plans, elevations, sections, and details, including attachments to other Work.
- b. Include duct entry provisions, including locations and duct sizes, and methods and materials for waterproofing duct entry locations.
- c. Include reinforcement details.
- d. Include frame and cover design and manhole chimneys.
- e. Include [ladder] [step] details.
- f. Include grounding details.
- g. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, sumps, and other accessories.
- h. Include joint details.

2. Factory-Fabricated Handholes and Boxes Other Than Precast Concrete:

- a. Include dimensioned plans, sections, and elevations, and fabrication and installation details.
- b. Include duct entry provisions, including locations and duct sizes, and methods and materials for waterproofing duct entry locations.
- c. Include cover design.
- d. Include grounding details.
- e. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, and other accessories.

C. Field quality-control reports.

## PART 2 - PRODUCTS

### 2.1 TYPE PVC RACEWAYS AND FITTINGS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 651 and UL CCN DZYR.

B. Schedule 40 Rigid PVC Conduit (PVC-40) and Fittings:

1. Dimensional Specifications: Schedule 40.

2. Options:

- a. Minimum Trade Size: **[Metric designator 16 (trade size 1/2)] [Metric designator 21 (trade size 3/4)]**.
- b. Markings: **[For use with maximum 90 deg C wire.] [For directional boring applications.]**

2.2 FITTINGS FOR CONDUIT, TUBING, AND CABLE

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.

2.3 SOLVENT CEMENTS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: As recommended by conduit manufacturer in accordance with UL 514B and UL CCN DWTT.

2.4 DUCT ACCESSORIES

- A. Duct Spacers: Factory-fabricated, rigid, PVC interlocking spacers; sized for type and size of duct with which used, and selected to provide minimum duct spacing indicated while supporting duct during concreting or backfilling.

2.5 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics:
  - a. ASTM C858 for design and manufacturing processes.
  - b. SCTE 77.

B. Polymer Concrete Handholes and Boxes with Polymer Concrete Cover:

1. Description: Molded of sand, concrete, and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or combination.
2. Configuration: Units must be designed for flush burial and have open bottom unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and installed location.

- a. Cover Finish: Nonskid finish must have minimum coefficient of friction of 0.50.
  - b. Cover Legend: Molded lettering, "ELECTRIC" or as indicated for each service.
4. Conduit Entrance Provisions: Conduit-terminating fittings must mate with entering ducts for secure, fixed installation in enclosure wall.
5. Options:
  - a. Color: Gray.

## 2.6 MANHOLES FOR EXTERIOR UNDERGROUND WIRING

### A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics:
  - a. ASTM C858 for design and manufacturing processes.
  - b. SCTE 77.

### B. Precast Concrete Manholes:

1. Description: One-piece units and units with interlocking mating sections, complete with accessories, hardware, and features.
2. Knockout Panels: Precast openings in walls, arranged to match dimensions and elevations of approaching duct, plus additional **12 inch (300 mm)** vertically and horizontally to accommodate alignment variations.
  - a. **[Splayed] [Center window]** location.
  - b. Knockout panels must be located no less than **6 inch (150 mm)** from interior surfaces of walls, floors, or roofs of manholes, but close enough to corners to facilitate racking of cables on walls.
  - c. Knockout panel opening must have cast-in-place, welded-wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct.
  - d. Knockout panel must be framed with at least two additional No. 3 steel reinforcing bars in concrete around each opening.
  - e. Knockout panels must be **1-1/2 to 2 inch (38 to 50 mm)** thick.

Retain "Duct Entrances in Manhole Walls" Subparagraph below to require end-bell or duct-terminating fittings to be factory installed, ready for connection to approaching ducts in field. This method reduces installation costs but may increase risk of potential alignment problems.

3. Duct Entrances in Manhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
  - a. Type and size: Match fittings to duct to be terminated.
  - b. Fittings must align with elevations of approaching duct and be located near interior corners of manholes to facilitate racking of cable.
  - c. Provide minimum of **[one] <Insert quantity>** cast end-bell or duct-terminating fitting of each size provided in each wall.

4. Ground Rod Sleeve: Provide 3 inch (75 mm) PVC sleeve in manhole floors 2 inch (50 mm) from wall adjacent to, but not underneath, duct entering structure.
5. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at installation location with ground-water level at grade.
6. Source Quality Control: Test and inspect in accordance with ASTM C1037.

## 2.7 UTILITY STRUCTURE ACCESSORIES

- A. Description: Utility equipment and accessory items used for utility structure access and utility support, listed and labeled for intended use and application and complying with the following local utility company requirements:]
  1. Utility company: Consolidated Edison (Con-Ed).
- B. Manhole Frames, Covers, and Chimney Components: Comply with structural design loading specified for manhole.
  1. Frame and Cover: Weatherproof, gray cast iron complying with ASTM A48/A48M, Class 30B with milled cover-to-frame bearing surfaces; diameter, 26 inch min.
    - a. Cover Finish: Nonskid finish must have minimum coefficient of friction of 0.50.
    - b. Special Covers: Recess in face of cover designed to accept finish material in paved areas.
  2. Cover Legend: Cast in; selected to suit system.
    - a. Legend:
      - 1) "ELECTRIC-LV" for duct systems with power wires and cables for systems operating at 600 V and less.
      - 2) For duct systems with medium-voltage cables, defer to Con-Ed Bluebook and referenced specifications.
  3. Manhole Chimney Components: Precast concrete rings with dimensions matched to those of roof opening.
    - a. Mortar for Chimney Ring and Frame and Cover Joints: Comply with ASTM C270, Type M, except for quantities less than 2.0 cu. ft (60 L) where packaged mix complying with ASTM C387/C387M, Type M, may be used.
    - b. Where joints are tongue and groove, Seal joints watertight using preformed plastic or rubber complying with ASTM C990. Install sealing material in accordance with sealant manufacturers' published instructions.
- C. Manhole Sump Frame and Grate: ASTM A48/A48M, Class 30B, gray cast iron.
- D. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2 inch (50 mm) diameter eye, and 1-by-4 inch (25-by-100 mm) bolt.

- E. Ground Rod Sleeve: 3 inch (75 mm) PVC sleeve in manhole floors 2 inch (50 mm) from wall adjacent to, but not underneath, ducts routed from facility.
- F. Fixed Manhole Ladders: Arranged for attachment to wall and floor of manhole. Ladder and mounting brackets and braces must be fabricated from nonconductive, structural-grade, fiberglass-reinforced resin.

## 2.8 DUCT SEALING

- A. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F (2 deg C). Compound must be capable of withstanding temperature of 300 deg F (150 deg C) without slump and adhering to clean surfaces of plastic ducts, metallic conduit, conduit and duct coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals. Duct sealing compound must be removable without damaging ducts or cables.
- B. Inflatable Duct-Sealing System: Wraparound inflatable bladder that seals ducts that are empty or containing conductors against air and water infiltration. System is suitable for use in steel, plastic, or concrete ducts and penetrations.

## 2.9 SOURCE QUALITY CONTROL

- A. Factory Tests for Handholes and Boxes:
  - 1. Factory Tests and Inspections: Perform the following tests and inspections on handholes and boxes, by, or under supervision of, qualified electrical testing laboratory recognized by authorities having jurisdiction, before delivering to site. Affix label with name and date of certification of system compliance.
    - a. Precast Concrete Utility Structures: Test and inspect in accordance with ASTM C1037.
    - b. Polymer Concrete and Nonconcrete Handhole and Pull-Box Prototypes: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests must be for specified tier ratings of products supplied. Testing machine pressure gages must have current calibration certification, complying with ISO 9000 and ISO 10012, and traceable to NIST standards.
  - 2. Nonconforming Work:
    - a. Equipment that does not pass tests and inspections will be considered defective.
  - 3. Factory Test Reports: Prepare and submit factory test and inspection reports.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Coordinate layout and installation of duct, duct bank, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in field. Notify Architect if there is conflict between areas of excavation and existing structures or archaeological sites to remain.
- B. Coordinate elevations of duct and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of duct and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct and duct bank will drain to manholes and handholes, and as approved by Architect.
- C. Clear and grub vegetation to be removed, and protect vegetation to remain in accordance with Section 311000 "Site Clearing." Remove and stockpile topsoil for reapplication in accordance with Section 311000 "Site Clearing."

### 3.2 SELECTION OF UNDERGROUND DUCTS

- A. Duct for Electrical Cables More Than 600 V: PVC-40, concrete encased unless otherwise indicated.
- B. Duct for Electrical Feeders 600 V and Less: PVC-40 unless otherwise indicated.
- C. Duct for Electrical Branch Circuits: PVC-40, direct buried unless otherwise indicated.
- D. Underground Ducts Crossing Paved Paths Walks and Driveways: PVC-40 encased in reinforced concrete.
- E. Underground Ducts Crossing Roadways and Railroads: PVC-40, encased in reinforced concrete.
- F. Stub-ups: Concrete encased, ERM-C-S.

### 3.3 SELECTION OF UNDERGROUND ENCLOSURES

- A. Handholes and Boxes:
  - 1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete, AASHTO HB 17, H-20 structural load rating.
  - 2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 15 structural load rating or greater.
  - 3. Units in Sidewalk and Similar Applications with Safety Factor for Nondeliberate Loading by Vehicles: Polymer concrete units, SCTE 77, Tier 8 structural load rating or greater.

4. Units Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested in accordance with SCTE 77 with 3000 lbf (13 345 N) vertical loading.
5. Cover design load must not exceed load rating of handhole or box.

B. Manholes: Precast concrete.

1. Units Located in Roadways and Other Deliberate Traffic Paths by Heavy or Medium Vehicles: H-20 structural load rating in accordance with AASHTO HB 17.
2. Units Not Located in Deliberate Traffic Paths by Heavy or Medium Vehicles: H-10 load rating in accordance with AASHTO HB 17.

3.4 EARTHWORK

- A. Excavation and Backfill: Comply with Section 312000 "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restoration: Restore area after construction vehicle traffic in immediate area is complete.
- C. Restore surface features at areas disturbed by excavation, and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- D. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Section 329200 "Turf and Grasses" and Section 329300 "Plants."
- E. Cut and patch existing pavement in path of underground duct, duct bank, and underground structures in accordance with "Cutting and Patching" Article in Section 017300 "Execution."

3.5 INSTALLATION OF DUCTS AND DUCT BANKS

A. Reference Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NEMA TCB 2 for installation of underground ducts and duct banks.
2. Consult Architect for resolution of conflicting requirements.

B. Special Techniques:

1. Where indicated on Drawings, install duct, spacers, and accessories into duct-bank configuration shown. Duct installation requirements in this Section also apply to duct bank.
2. Steel raceway, bends, and fittings in single duct run or duct bank must be of same type.
3. Slope: Pitch duct minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope duct from high point between two manholes to drain in both directions.
4. Expansion and Deflection Fittings: Install expansion and deflection fitting in each duct in area of disturbed earth adjacent to manhole or handhole.



5. Install expansion fitting near center of straight line duct with calculated expansion of more than 3/4 inch (19 mm).
6. Curves and Bends:
  - a. Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with minimum radius of 48 inch both horizontally and vertically, at other locations unless otherwise indicated.
  - b. Field bending must be in accordance with NFPA 70 minimum radii requirements, except bends over 45 degrees must be made with minimum radius of 48 inch. Use only equipment specifically designed for material and size involved. Use PVC heating bender for bending PVC conduit.
7. Joints: Use solvent-cemented joints in nonmetallic duct and fittings and make watertight in accordance with manufacturer's published instructions. Stagger couplings so those of adjacent duct do not lie in same plane. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with minimum 3 inch (75 mm) of concrete for minimum of 12 inch (300 mm) on each side of coupling.
  - a. Install insulated grounding bushings on steel raceway terminations that are less than 12 inch (300 mm) below grade or floor level and do not terminate in hubs.
8. Installation Adjacent to High-Temperature Steam Lines: Where duct is installed parallel to underground steam lines, perform calculations showing duct will not be subject to environmental temperatures above 104 deg F (40 deg C). Where environmental temperatures are calculated to rise above 104 deg F (40 deg C), and anywhere duct crosses above underground steam line, install insulation blankets listed for direct burial to isolate duct bank from steam line to maintain maximum environmental temperature of 104 deg F (40 deg C).
9. Building Wall Penetrations: Make transition from underground duct to steel raceway at least 10 ft (3 m) outside building wall, without reducing duct line slope away from building and without forming trap in line. Use fittings manufactured for transition to steel raceway type installed. Install steel raceway penetrations of building walls as specified in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
10. Install manufactured steel raceway elbows for stub-ups at poles unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
  - a. Couple steel elbows to ducts with adapters designed for this purpose, and encase coupling with minimum 3 inch (75 mm) of concrete for minimum of 12 inch (300 mm) on each side of coupling.
11. Sealing: Provide temporary closure at terminations of duct with pulled cables. Seal spare duct at terminations. Use sealing compound and plugs to withstand at least 15 psig (1.03 MPa) hydrostatic pressure.
12. Pulling Cord: Install 200 lbf (1000 N) test nylon cord in empty ducts.
13. Concrete-Encased Ducts and Duct Bank:
  - a. Excavate trench bottom to provide firm and uniform support for duct. Prepare trench bottoms as specified in Section 312000 "Earth Moving" for pipes 6 inch (150 mm) or less in nominal diameter.
  - b. Depth: Install so top of duct envelope is at least 24 inch (600 mm) below finished grade in areas not subject to deliberate traffic, and at least 30 inch (750 mm) below

- finished grade in deliberate traffic paths for vehicles unless otherwise indicated. Install so top of duct envelope is below local frost line.
- c. Support duct on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
  - d. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than four spacers per 20 ft (6 m) of duct. Place spacers within 24 inch (600 mm) of duct ends. Stagger spacers approximately 6 inch (150 mm) between tiers. Secure spacers to earth and to duct to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
  - e. Minimum Space between Ducts: 3 inch (75 mm) between edge of duct and exterior envelope wall, 2 inch (50 mm) between ducts for like services, and 4 inch (100 mm) between power and communications ducts.
  - f. Elbows:
    - 1) Use manufactured steel elbows for stub-ups, at building entrances, and at changes of direction in duct run.
  - g. Stub-ups to Outdoor Equipment: Extend concrete-encased steel raceway horizontally minimum of 60 inch (1500 mm) from edge of equipment base.
    - 1) Stub-ups must be minimum 4 inch (100 mm) above finished floor and minimum 3 inch (75 mm) from conduit side to edge of slab.
  - h. Stub-ups to Indoor Equipment: Extend concrete-encased steel raceway horizontally minimum of 60 inch (1500 mm) from edge of wall. Install insulated grounding bushings on terminations at equipment.
    - 1) Stub-ups must be minimum 4 inch (100 mm) above finished floor and no less than 3 inch (75 mm) from conduit side to edge of slab.
  - i. Reinforcement: Reinforce concrete-encased duct where crossing disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
  - j. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
  - k. Concrete Cover: Install minimum of 3 inch (75 mm) of concrete cover between edge of duct to exterior envelope wall, 2 inch (50 mm) between duct of like services, and 4 inch (100 mm) between power and communications ducts.
  - l. Place minimum 6 inch (150 mm) of engineered fill above concrete encasement of duct.
  - m. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
    - 1) Start at one end and finish at other, allowing for expansion and contraction of duct as its temperature changes during and after pour. Use expansion fittings installed in accordance with manufacturer's published instructions, or use other specific measures to prevent expansion-contraction damage.
    - 2) If more than one pour is necessary, terminate each pour in vertical plane and install 3/4 inch (15 mm) reinforcing-rod dowels extending minimum of

18 inch (450 mm) into concrete on both sides of joint near corners of envelope.

- n. Pouring Concrete: Comply with requirements in "Concrete Placement" Article in Section 033000 "Cast-in-Place Concrete." Place concrete carefully during pours to prevent voids under and between duct and at exterior surface of envelope. Do not allow heavy mass of concrete to fall directly onto ducts. Allow concrete to flow around duct and rise up in middle, uniformly filling open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-installation application.

14. Direct-Buried Duct and Duct Bank:

- a. Excavate trench bottom to provide firm and uniform support for duct. Comply with requirements in Section 312000 "Earth Moving" for preparation of trench bottoms for pipes less than 6 inch (150 mm) in nominal diameter.
- b. Depth: Install top of duct at least 36 inch (900 mm) below finished grade unless otherwise indicated.
- c. Set elevation of top of duct bank below frost line.
- d. Place minimum 3 inch (75 mm) of sand as bed for duct. Place sand to minimum of 6 inch (150 mm) above top level of duct.
- e. Support ducts on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
- f. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than four spacers per 20 ft (6 m) of duct. Place spacers within 24 inch (600 mm) of duct ends. Stagger spacers approximately 6 inch (150 mm) between tiers. Secure spacers to earth and to ducts to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
- g. Install duct with minimum of 3 inch (75 mm) between ducts for like services and 6 inch (150 mm) between power and communications duct.
- h. Install manufactured steel elbows for stub-ups, at building entrances, and at changes of direction in duct.
  - 1) Couple RNC duct to steel raceway with adapters designed for this purpose, and encase coupling with minimum 3 inch (75 mm) of concrete.
  - 2) Stub-ups to Outdoor Equipment: Extend concrete-encased steel raceway horizontally minimum of 60 inch (1500 mm) from edge of base. Install insulated grounding bushings on terminations at equipment.
    - a) Stub-ups must be minimum 4 inch (100 mm) above finished base and minimum 3 inch (75 mm) from conduit side to edge of base.
  - 3) Stub-ups to Indoor Equipment: Extend concrete-encased steel raceway horizontally on exterior of wall minimum of 60 inch (1500 mm) from edge of wall. Install insulated grounding bushings on terminations at equipment.
  - 4) Stub-ups through interior floors must be minimum 4 inch (100 mm) above finished floor and no less than 3 inch (75 mm) from conduit side to edge of equipment pad or floor slab.

- i. After installing first tier of duct, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4 inch (100 mm) over duct and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply with requirements in Section 312000 "Earth Moving" for installation of backfill materials.
15. Warning Planks: Bury warning planks approximately 12 inch (300 mm) above direct-buried duct, placing them 36 inch (900 mm) o.c. Align planks along width and along centerline of duct or duct bank. Provide additional plank for each 12 inch (300 mm) increment of duct-bank width over nominal 18 inch (450 mm). Space additional planks 12 inch (300 mm) apart, horizontally across width of ducts.
16. Underground-Line Warning Tape: Bury detectable underground line specified in Section 260553 "Identification for Electrical Systems" no less than 12 inch (300 mm) above concrete-encased duct and duct banks and approximately 12 inch (300 mm) below grade. Align tape parallel to and within 3 inch (75 mm) of centerline of duct bank. Provide additional warning tape for each 12 inch (300 mm) increment of duct-bank width over nominal 18 inch (450 mm). Space additional tapes 12 inch (300 mm) apart, horizontally across width of ducts.
17. Ground ducts and duct banks in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

### 3.6 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

#### A. Reference Standards:

1. Precast Concrete Handholes: Comply with ASTM C891 unless otherwise indicated.
2. Consult Architect for resolution of conflicting requirements.

#### B. Special Techniques:

1. Precast Concrete Handholes and Manholes:
  - a. Install units level and plumb and with orientation and depth coordinated with connecting duct to minimize bends and deflections required for proper entrances.
  - b. Unless otherwise indicated, support units on level bed of crushed stone or gravel graded from 1 inch (25 mm) sieve to No. 4 (4.75 mm) sieve and compacted to same density as adjacent undisturbed earth.
  - c. Field-cut openings for conduits in accordance with enclosure manufacturer's published instructions. Cut wall of enclosure with tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
2. Elevations:
  - a. Manhole Roof: Install with rooftop at least 15 inch (375 mm) below finished grade.

- b. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1 inch (25 mm) above finished grade.
  - c. Install handholes with bottom below frost line.
  - d. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.
  - e. Where indicated, cast handhole cover frame integrally with handhole structure.
3. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.
4. Manhole Access: Circular opening in manhole roof; sized to match cover size.
  - a. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.
  - b. Install chimney, constructed of cast-iron collars and rings, and cast-iron frame to connect cover with manhole roof opening. Provide moisture-tight joints and waterproof grouting for frame and chimney.
5. Hardware: Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.
6. Fixed Manhole Ladders: Arrange to provide for safe entry with maximum clearance from cables and other items in manholes.
7. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inch (97 mm) for manholes and 2 inch (50 mm) for handholes, for anchor bolts installed in field. Use minimum of two anchors for each cable stanchion.
8. Ground manholes, handholes, and boxes in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

### 3.7 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

#### A. Special Techniques:

1. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of duct, and seal joint between box and extension as recommended by manufacturer.
2. Unless otherwise indicated, support units on level bed of crushed stone or gravel, graded from 1/2 inch (12.5 mm) sieve to No. 4 (4.75 mm) sieve and compacted to same density as adjacent undisturbed earth.
3. Elevation: In paved areas and trafficways, set cover flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.
4. Install handholes and boxes with bottom below frost line.
5. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.
6. Field cut openings for duct in accordance with enclosure manufacturer's published instructions. Cut wall of enclosure with tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
7. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour concrete ring encircling, and in contact with

enclosure entry, and with top surface screeded to top of box cover frame. Bottom of ring must rest on compacted earth.

- a. Concrete: 3000 psi (20 kPa), 28-day strength, complying with Section 033000 "Cast-in-Place Concrete," with troweled finish.
  - b. Dimensions: 10 inch wide by 12 inch deep (250 mm wide by 300 mm deep).
8. Ground handholes and boxes in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

### 3.8 FIELD QUALITY CONTROL

#### A. Tests and Inspections:

1. Demonstrate capability and compliance with requirements on completion of installation of underground duct, duct bank, and utility structures.
2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide minimum 12 inch (300 mm) long mandrel equal to duct size minus 1/4 inch (6 mm). If obstructions are indicated, remove obstructions and retest.
3. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 260526 "Grounding and Bonding for Electrical Systems."

#### B. Nonconforming Work:

1. Underground ducts, raceways, and structures will be considered defective if they do not pass tests and inspections.
2. Correct deficiencies and retest as specified above to demonstrate compliance.

#### C. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.

### 3.9 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of duct until duct cleaner indicates that duct is clear of dirt and debris. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of manholes, including sump, and building interiors affected by Work.
1. Sweep floor, removing dirt and debris.
  2. Remove foreign material.

END OF SECTION 260543

## SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Round sleeves.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Pourable sealants.
6. Foam sealants.

##### B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
3. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

#### 1.2 ACTION SUBMITTALS

##### A. Product Data: For each type of product.

### PART 2 - PRODUCTS

#### 2.1 ROUND SLEEVES

##### A. Steel Wall Sleeves:

1. General Characteristics: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends and integral waterstop.

##### B. Cast-Iron Wall Sleeves:

1. General Characteristics: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop.

## 2.2 SLEEVE-SEAL SYSTEMS

- A. General Characteristics: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable or between raceway and cable.
- B. Options:
  - 1. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 2. Pressure Plates: Stainless steel.
  - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

## 2.3 SLEEVE-SEAL FITTINGS

- A. General Characteristics: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit must have plastic or rubber waterstop collar with center opening to match piping OD.

## 2.4 GROUT

- A. General Characteristics: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
  - 1. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
  - 2. Design Mix: 5000 psi (34.5 MPa), 28-day compressive strength.
  - 3. Packaging: Premixed and factory packaged.

## 2.5 FOAM SEALANTS

- A. Performance Criteria:
  - 1. General Characteristics: Multicomponent, liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam. Foam expansion must not damage cables or crack penetrated structure.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. 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 space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall or floor so no voids remain. Tool exposed surfaces smooth; protect material while curing.
      - b. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
    2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
    3. Size pipe sleeves to provide 1/4 inch (6.4 mm) annular clear space between sleeve and raceway or cable, unless sleeve-seal system is to be installed or seismic criteria require different clearance.
    4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
  - B. Sleeves for Conduits Penetrating Non-Fire-Rated Wall Assemblies:
    1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
    2. Seal space outside of sleeves with approved joint compound for wall assemblies.
  - C. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
  - D. Aboveground, Exterior-Wall Penetrations: Seal penetrations using cast-iron pipe sleeves and mechanical sleeve-seal systems. Size sleeves to allow for 1 inch (25 mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
  - E. Underground, Exterior-Wall and Floor Penetrations:
    1. Install cast-iron pipe sleeves with integral waterstops. Size sleeves to allow for 1 inch (25 mm) annular clear space between raceway or cable and sleeve for installing sleeve-seal system. Install sleeve during construction of floor or wall.
- 3.2 INSTALLATION OF SLEEVE-SEAL SYSTEMS
- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
  - B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

END OF SECTION 260544

## SECTION 260548 - VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Elastomeric isolation pads.
2. Restraints - rigid type.
3. Restraints - cable type.
4. Restraint accessories.
5. Post-installed concrete anchors.
6. Concrete inserts.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
3. Section 260529 "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.

#### 1.2 ACTION SUBMITTALS

A. Product Data:

1. Elastomeric isolation pads.
2. Restraints - rigid type.
3. Restraints - cable type.
4. Restraint accessories.
5. Post-installed concrete anchors.
6. Concrete inserts.

B. Shop Drawings:

1. Detail fabrication and assembly of equipment bases.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
3. Show coordination of seismic and wind-load bracing for components with other systems and equipment in the vicinity, including other supports and seismic restraints.

- C. Delegated Design Submittal for Each Seismic-Restraint Device: Signed and sealed by qualified structural professional engineer.
  - 1. For each seismic-restraint device, including restraint - rigid and cable type, restraint accessory, and concrete anchor and insert that is required by this Section or is indicated on Drawings, submit the following:
    - a. Seismic Restraints: Select seismic restraints complying with performance requirements, design criteria, and analysis data.
    - b. Post-Installed Concrete Anchors and Inserts: Include calculations showing anticipated seismic loads. Include certification that device is approved by qualified testing laboratory for seismic reinforcement use.
    - c. Seismic Design Calculations: Submit input data and loading calculations prepared in accordance with criteria specified in Section 260010 "Supplemental Requirements for Electrical" and Section 260011 "Facility Performance Requirements for Electrical."
  - 2. Seismic- and Wind-Load-Restraint Detail Drawings: Signed and sealed by qualified structural professional engineer.
    - a. Design Analysis: To support selection and arrangement of seismic and wind-load restraints. Include calculations of combined tensile and shear loads.
    - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
    - c. Coordinate seismic-restraint details with wind-load details required for equipment mounted outdoors.
  - 3. Product Listing, Preapproval, and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
- D. Field quality-control reports.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage qualified structural professional engineer to design seismic and wind-load control system in accordance with criteria specified in Section 260010 "Supplemental Requirements for Electrical" and Section 260011 "Facility Performance Requirements for Electrical."
- B. Seismic- and Wind-Load-Restraint Device Load Ratings: Devices to be tested and rated in accordance with applicable code requirements and authorities having jurisdiction. Devices to be listed by a nationally recognized third party that requires periodic follow-up inspections and has

a listing directory available to the public. Provide third-party listing by one or more of the following: an agency acceptable to authorities having jurisdiction.

- C. Consequential Damage: Provide additional seismic and wind-load restraints for suspended components or anchorage of floor-, roof-, or wall-mounted components so that failure of a non-essential or essential component will not cause failure of any other essential building component.
- D. Fire/Smoke Resistance: Seismic- and wind-load-restraint devices that are not constructed of ferrous metals must have a maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested by qualified testing laboratory in accordance with ASTM E84 or UL 723, and be so labeled.
- E. Component Supports:
  - 1. Load ratings, features, and applications of reinforcement components must be based on testing standards of qualified testing laboratory.

## 2.2 ELASTOMERIC ISOLATION PADS

- A. Elastomeric Isolation Pads:
  - 1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
  - 2. Size: Factory or field cut to match requirements of supported equipment.
  - 3. Pad Material: Oil and water resistant with elastomeric properties. Neoprene rubber, silicone rubber, or other elastomeric material.
  - 4. Surface Pattern: Smooth, ribbed, or waffle pattern.
  - 5. Infused nonwoven cotton or synthetic fibers.
  - 6. Load-bearing metal plates adhered to pads.
  - 7. Sandwich-Core Material: Resilient and elastomeric.

## 2.3 RESTRAINTS - RIGID TYPE

- A. Description: Shop- or field-fabricated bracing assembly made of ANSI/AISI S110-07-S1 slotted steel channels, ANSI/ASTM A53/A53M steel pipe, or other rigid steel brace member. Includes accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

## 2.4 RESTRAINTS - CABLE TYPE

- A. Seismic- and Wind-Load-Restraint Cables: **ASTM A492 stainless steel** cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for seismic-restraining cable service; with fittings attached by means of poured socket, swaged socket, or mechanical (Flemish eye) loop.

- B. Restraint cable assembly and cable fittings must comply with ASCE/SEI 19. Cable fittings and complete cable assembly must maintain the minimum cable breaking force. U-shaped cable clips and wedge-type end fittings do not comply and are unacceptable.

## 2.5 RESTRAINT ACCESSORIES

- A. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod. Non-metallic stiffeners are unacceptable.
- B. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.
- C. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
- D. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.
- E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

## 2.6 POST-INSTALLED CONCRETE ANCHORS

- A. Mechanical Anchor Bolts:
  - 1. Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength for anchor and as tested according to ASTM E488/E488M.
- B. Adhesive Anchor Bolts:
  - 1. Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488/E488M.
- C. Provide post-installed concrete anchors that have been prequalified for use in seismic and wind-load applications.
  - 1. Prequalify post-installed anchors in concrete in accordance with ACI 355.2 or other approved qualification testing procedures.
  - 2. Prequalify post-installed anchors in masonry in accordance with approved qualification procedures.
- D. Expansion-type anchor bolts are not permitted for equipment in excess of 10 hp (7.46 kW) that is not vibration isolated.

1. Undercut expansion anchors are permitted.

## 2.7 CONCRETE INSERTS

- A. Provide preset concrete inserts that are seismically prequalified in accordance with ICC-ES AC446 testing.
- B. Comply with MSS SP-58.

## 2.8 SOURCE QUALITY CONTROL

- A. Product Data: Prepare and submit catalog cuts, brochures, diagrams, schedules, and performance data illustrating size, physical appearance, and other characteristics of product.
  1. Include rated load capacity for each seismic- and wind-load-restraint device.
  2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic- and wind-load-restraint component used.
  3. Annotate types and sizes of seismic restraints and accessories, complete with listing markings or report numbers and load rating in tension and compression as evaluated by an agency acceptable to authorities having jurisdiction.
  4. Annotate to indicate application of each product submitted and compliance with requirements.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and equipment to receive seismic and wind-load control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 APPLICATIONS

- A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by **an agency acceptable to authorities having jurisdiction**.
- B. Hanger-Rod Stiffeners: Install where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods caused by seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry static, wind load, and seismic loads within specified loading limits.

### 3.3 INSTALLATION OF SEISMIC-RESTRAINT AND WIND-LOAD CONTROL DEVICES

- A. Provide seismic restraint and wind-load control devices for systems and equipment where indicated in Equipment Schedules or Seismic and Wind-Load Controls Schedule, where indicated on Drawings, where the Specifications indicate they are to be installed on specific equipment and systems, and where required by applicable codes.
  - 1. Install equipment and devices to withstand the effects of earthquake motions and high wind events.
- B. Coordinate location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."
- C. Installation of seismic and wind-load restraints must not cause any stresses, misalignment, or change of position of equipment or conduits.
- D. Equipment Restraints:
  - 1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
  - 2. Install seismic-restraint and wind-load-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.
- E. Raceway, Cable, Wireway, Cable Tray, and Busway Support and Hanger Restraints:
  - 1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
  - 2. Install seismic-restraint and wind-load-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.
  - 3. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
  - 4. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- F. Install cables so they do not bend across edges of adjacent equipment or building structure.
- G. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- H. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- I. Post-Installed Concrete Anchors:
  - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify structural engineer if reinforcing steel or other embedded items are encountered

- during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
  3. Mechanical-Type Anchor Bolts: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors must be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
  4. Adhesive-Type Anchor Bolts: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
  5. Set anchors to manufacturer's recommended torque using a torque wrench.
  6. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

### 3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where connection is terminated to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

### 3.5 FIELD QUALITY CONTROL

- A. Tests and Inspections:
  1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
  2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
  3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
  4. Test no fewer than four of each type and size of installed anchors and fasteners selected by Architect.
  5. Test to 90 percent of rated proof load of device.
- B. Nonconforming Work:
  1. Seismic controls will be considered defective if they do not pass tests and inspections.
  2. Remove and replace malfunctioning units and retest as specified above.
- C. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.

END OF SECTION 260548



## SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Labels.
2. Extruded insulating tubing.
3. Bands.
4. Tapes and stencils.
5. Tags.
6. Signs.
7. Cable ties.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Identification Schedule: For each piece of electrical equipment and electrical system components to be index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

### PART 2 - PRODUCTS

#### 2.1 LABELS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN PGDQ2 for components; including UL 969.

- B. UL PGDQ2 - Vinyl Wraparound Labels: Preprinted, flexible labels laminated with clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
- C. UL PGDQ2 - Self-Adhesive Wraparound Labels: Preprinted, 3 mil (0.08 mm) thick, polyester flexible label with acrylic pressure-sensitive adhesive.
  - 1. Self-Lamination: Clear; UV-, weather-, and chemical-resistant; self-laminating, with protective shield over legend. Size labels such that clear shield overlaps entire printed legend.
  - 2. Marker for Labels:
    - a. Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.
- D. UL PGDQ2 - Self-Adhesive Labels: Polyester, thermal, transfer-printed, 3 mil (0.08 mm) thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
  - 1. Minimum Nominal Size:
    - a. 1-1/2 by 6 inch (37 by 150 mm) for raceway and conductors.
    - b. 3-1/2 by 5 inch (76 by 127 mm) for equipment.
    - c. As required by authorities having jurisdiction.
  - 2.

## 2.2 TAPES AND STENCILS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mil (0.08 mm) thick by 1 to 2 inch (25 to 50 mm) wide; compounded for outdoor use.
- C. Tape and Stencil: 4 inch (100 mm) wide black stripes on 10 inch (250 mm) centers placed diagonally over orange background and are 12 inch (300 mm) wide. Stop stripes at legends.
- D. Underground-Line Warning Tape:
  - 1. Tape:
    - a. Recommended by manufacturer for method of installation and suitable to identify and locate underground electrical and communications utility lines.
    - b. Printing on tape must be permanent and may not be damaged by burial operations.
    - c. Tape material and ink must be chemically inert and not be subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
  - 2. Color and Printing:
    - a. Comply with APWA Uniform Color Code using NEMA Z535.1 safety colors.
    - b. Inscriptions for Red Tapes: "CAUTION BURIED ELECTRIC LINE BELOW".

- c. Inscriptions for Orange Tapes: "CAUTION BURIED COMMUNICATION LINE BELOW".
- 3. Reinforced Detectable Line-Warning Tape:
  - a. Reinforced, detectable three-layer laminate, consisting of printed pigmented woven scrim, solid aluminum-foil core, and clear protective film that allows inspection of continuity of conductive core; bright-colored, continuous-printed on one side with inscription of utility, compounded for direct-burial service.
  - b. Width: 3 inch (75 mm).
  - c. Overall Thickness: 8 mil (0.2 mm).
  - d. Foil Core Thickness: 0.35 mil (8.9 m).
  - e. Weight: 34 lb/1000 sq. ft (16.6 kg/100 sq. m).
  - f. Tensile in accordance with ASTM D882: 300 lbf (1334 N) and 12,500 psi (86.1 MPa).

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

#### 3.2 SELECTION OF COLORS AND IDENTIFICATION MARKINGS

- A. Comply with 29 CFR 1910.144 for color identification of hazards, and the following:
  - 1. Fire-protection and fire-alarm equipment, including raceways, must be finished, painted, or suitably marked safety red.
  - 2. Ceiling-mounted hangers, supports, cable trays, and raceways must be finished, painted, or suitably marked safety yellow where less than 7.7 ft above finished floor.
- B. Pipe and Conduit Labeling: Comply with ASME A13. and IEEE C2.
- C. Color-Coding for Phase- and Voltage-Level Identification, 1000 V or Less: Use colors listed below for ungrounded service, feeder, and branch-circuit conductors.
  - 1. Color must be factory applied.
  - 2. Colors for 208Y/120 V Circuits:
    - a. Phase A: Black.
    - b. Phase B: Red.
    - c. Phase C: Blue.
  - 3. Colors for 240 V Circuits:
    - a. Phase A: Black.

- b. Phase B: Red.
- 4. Colors for 480Y/277 V Circuits:
  - a. Phase A: Brown.
  - b. Phase B: Orange.
  - c. Phase C: Yellow.
- 5. Color for Neutral (Grounded Conductor): White or gray.
- 6. Color for Equipment Ground: Green.
- 7. Color for Isolated Ground: Green with two or more yellow stripes.
- D. Color-Coding Instructional Signs: Self-adhesive labels, including color code for grounded and ungrounded conductors.
- E. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- F. Locations of Underground Lines: Underground-line warning tape for power and lighting.
- G. Vaults, Manholes, Handholes, and Pull and Junction Boxes, More Than 1000 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use write-on tags colored and marked to indicate phase, and separate tag with circuit designation.
- H. Vaults, Manholes, Handholes, and Pull and Junction Boxes, 1000 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use self-adhesive wraparound labels to identify phase.
  - 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50 ft (15 m) maximum intervals in straight runs, and at 25 ft (7.6 m) maximum intervals in congested areas.
  - 2. Identify system voltage and system or service type with black letters on orange field.
- I. Accessible Raceways and Metal-Clad Cables, 1000 V or Less, for Service, Feeder, and Branch Circuits, More Than 30A and 120V to Ground: Identify with self-adhesive raceway labels.
  - 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50 ft (15 m) maximum intervals in straight runs, and at 25 ft (7.6 m) maximum intervals in congested areas.
  - 2. Identify system voltage and system or service type with black letters on orange field.
- J. Cover Plates: Label individual cover plates with self-adhesive labels. Place label at top of cover plate. Label cover plate with the following information, in the order listed:
  - 1. Panelboard designation.
  - 2. Colon or dash.
  - 3. Branch circuit number.
- K. Equipment Identification Labels:
  - 1. Black letters on white field.

2. Indoor Equipment: Self-adhesive label.
3. Outdoor Equipment: Laminated acrylic or melamine sign.
4. Equipment to Be Labeled:
  - a. Panelboards: Typewritten directory of circuits in location provided by panelboard manufacturer. Panelboard identification must be in form of **engraved** laminated acrylic or melamine label.
  - b. Enclosures and electrical cabinets.
  - c. Access doors and panels for concealed electrical items.
  - d. Switchgear.
  - e. Switchboards.
  - f. Transformers: Label that includes tag designation indicated on Drawings for transformer, feeder, and panelboards or equipment supplied by secondary.
  - g. Substations.
  - h. Emergency system boxes and enclosures.
  - i. Motor-control centers.
  - j. Enclosed switches.
  - k. Enclosed circuit breakers.
  - l. Enclosed controllers.
  - m. Variable-speed controllers.
  - n. Push-button stations.
  - o. Power-transfer equipment.
  - p. Contactors.
  - q. Remote-controlled switches, dimmer modules, and control devices.
  - r. Uninterruptible power supplies.
  - s. Battery-inverter units.
  - t. Power-generating units.
  - u. Monitoring and control equipment.

L. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

### 3.3 SELECTION OF SIGNS AND HAZARD MARKINGS

A. Comply with 29 CFR 1910.145 for danger, caution, warning, and safety instruction signs.

B. Signs, labels, and tags required for personnel safety must comply with the following standards:

1. Safety Colors: NEMA Z535.1.
2. Facility Safety Signs: NEMA Z535.2.
3. Safety Symbols: NEMA Z535.3.
4. Product Safety Signs and Labels: NEMA Z535.4.
5. Safety Tags and Barricade Tapes for Temporary Hazards: NEMA Z535.5.

C. Electrical Hazard Warnings:

1. Arc-Flash Hazard Warning: Self-adhesive labels. Comply with NFPA 70E and Section 260573.19 "Arc-Flash Hazard Analysis" requirements for arc-flash hazard warning labels.

2. Raceways and Cables Carrying Circuits at More Than 1000 V:
    - a. Black letters on orange field.
    - b. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."
  3. Multiple Power Sources Warning Legend: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
  4. OSHA Workspace Clearance Warning Legend: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 3 FEET MINIMUM."
- D. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.
1. Apply to exterior of door, cover, or other access.
  2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
    - a. Power-transfer switches.
    - b. Controls with external control power connections.

### 3.4 INSTALLATION

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes typical for electrical equipment environments specified in Section 260011 "Facility Performance Requirements for Electrical."
- C. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- D. Fasteners for Labels and Signs: Self-tapping, stainless steel screws or stainless steel machine screws with nuts and flat and lock washers.
- E. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- F. Install identifying devices before installing acoustical ceilings and similar concealment.
- G. Verify identity of item before installing identification products.
- H. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

- I. Apply identification devices to surfaces that require finish after completing finish work.
- J. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- K. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from floor.
- L. Vinyl Wraparound Labels:
  - 1. Secure tight to surface of raceway or cable at location with high visibility and accessibility.
  - 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to location and substrate.
- M. Self-Adhesive Wraparound Labels: Secure tight to surface at location with high visibility and accessibility.
- N. Marker Tapes: Secure tight to surface at location with high visibility and accessibility.
- O. Self-Adhesive Vinyl Tape: Secure tight to surface at location with high visibility and accessibility.
- P. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.
- Q. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's instructions.
- R. Underground Line Warning Tape:
  - 1. During backfilling of trenches, install continuous underground-line warning tape not less than 12 inch (300 mm) directly above cables or raceways buried 18 inch (450 mm) or more below grade. Use multiple tapes where width of multiple lines installed in common trench **or concrete envelope** exceeds 16 inch (400 mm) overall.
  - 2. Install underground-line warning tape for direct-buried cables and cables in raceways.
- S. Baked-Enamel Signs: Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.
- T. Metal-Backed Butyrate Signs: Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.
- U. Laminated Acrylic or Melamine Plastic Signs: Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.

END OF SECTION 260553

## SECTION 260573 - POWER SYSTEM STUDIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. The Work of this Section Includes:

1. Short-circuit study.
2. Overcurrent protective device coordination study.
3. Load-flow and voltage-drop study.
4. Motor-starting study.
5. Arc-flash hazard study.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" specifies additional requirements applicable to coordinating, scheduling, and sequencing of the Work specified in this Section.

#### 1.2 ACTION SUBMITTALS

A. Power System Study Reports:

1. Submit reports after approval of system protective devices submittals. Submittals must be in digital form.
2. Submit short-circuit study input data, including completed computer-program input data sheets.
3. Submit coordination study input data, including completed computer-program input data sheets.
  - a. Submit load-flow, voltage-drop, and motor-starting data with coordination study.
4. Submit arc-flash study input data, including completed computer-program input data sheets.
5. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.
6. Submit revised one-line diagram, reflecting field investigation results and results of short-circuit study.

B. Data files for studies in format compatible with Owner's power system analysis software.



### 1.3 QUALITY ASSURANCE

- A. Submittals for power system studies must be signed and sealed by qualified electrical professional engineer responsible for their preparation.
- B. Studies must be performed using commercially developed and distributed software designed specifically for power system analysis.
- C. Software algorithms must comply with requirements of standards and guides specified in this Section.
- D. Manual calculations are unacceptable.

## PART 2 - PRODUCTS

### 2.1 POWER SYSTEM ANALYSIS SOFTWARE

- A. Standard Features:
  - 1. Power System Analysis:
    - a. Power-systems-analysis software applications must have analytical capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 3002 series standards.
    - b. Computer software application must be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program must report device settings and ratings of overcurrent protective devices and must demonstrate selective coordination by computer-generated, time-current coordination plots.
    - c. Computer software application must be designed to perform arc-flash analysis or have function, component, or add-on module designed to perform arc-flash analysis.
  - 2. Analysis Standards:
    - a. Short-Circuit Current Analysis: In accordance with IEEE 3002.3.
    - b. Device Coordination Analysis: In accordance with IEEE 3004.3 and IEEE 3004.5.
    - c. Load-Flow Analysis: In accordance with IEEE 3002.2.
    - d. Motor-Starting Analysis: In accordance with IEEE 3002.7.
    - e. Harmonic Analysis: In accordance with IEEE 3002.8.
    - f. Transient Stability Analysis: In accordance with IEEE P3002.9.
    - g. Arc-Flash Hazard Analysis: In accordance with IEEE 1584.
  - 3. Capable of printing arc-flash hazard warnings for equipment on [polyester] [vinyl], weather- and UV-resistant, pressure-sensitive adhesive labels complying with NFPA 70E.

- a. Label must have orange header with wording, "WARNING, ARC-FLASH HAZARD," and must include the following information taken directly from arc-flash hazard study:
  - 1) Equipment designation.
  - 2) Nominal voltage.
  - 3) Protection boundaries.
    - a) Arc-flash boundary.
    - b) Restricted approach boundary.
    - c) Limited approach boundary.
  - 4) Arc-flash PPE category.
  - 5) Required minimum arc rating of PPE in Cal/cm squared.
  - 6) Available incident energy.
  - 7) Working distance.
  - 8) Engineering report number, revision number, and issue date.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Collect and analyze data for power system studies.
  - 1. Verify completeness of data supplied in one-line diagram on Drawings. Call discrepancies to Architect's attention.
  - 2. For equipment included as Work on the Project, use characteristics submitted under provisions of action submittals and information submittals for the Project.
  - 3. For equipment that is existing to remain, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers in accordance with NFPA 70E.
  - 4. Gather and tabulate required input data to support power system studies. Comply with requirements in Section 017839 "Project Record Documents" for recording circuit protective device characteristics. Record data on Record Document copy of one-line diagram. Comply with recommendations in IEEE 3002 series standards as to amount of detail that is required to be acquired in field. Field data gathering must be by, or under supervision of, qualified electrical professional engineer. Data include, but are not limited to, the following:
    - a. Product data for the Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
    - b. Electrical power utility impedance at service.
    - c. Power sources and ties.
    - d. Short-circuit current at each system bus (three phase and line to ground).
    - e. Full-load current of loads.
    - f. Voltage level at each bus.

- g. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
- h. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
- i. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
- j. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
- k. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
- l. Maximum demands from service meters.
- m. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
- n. Motor horsepower and NEMA MG 1 code letter designation.
- o. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
- p. Medium-voltage cable sizes, lengths, conductor material, cable construction, metallic shield performance parameters, and conduit material (magnetic or nonmagnetic).
- q. Derating factors.

### 3.2 PREPARATION

#### A. Preparation of Data for Short-Circuit Study:

- 1. Verify completeness of data supplied on one-line diagram. Call discrepancies to Architect's attention.
- 2. For equipment included as Work on the Project, use characteristics submitted under provisions of action submittals and information submittals for the Project.
- 3. Prepare one-line diagram of modeled power system, showing the following:
  - a. Protective device designations and ampere ratings.
  - b. Conductor types, sizes, and lengths.
  - c. Transformer kVA and voltage ratings.
  - d. Motor and generator designations and kVA ratings.
  - e. Switchgear, switchboard, motor-control center, and panelboard designations and ratings.
  - f. Derating factors and environmental conditions.
  - g. Revisions to electrical equipment required by study.

#### B. Preparation of Data for Overcurrent Protective Device Coordination Study:

- 1. Prepare data sheets to supplement electrical distribution system one-line diagram, cross-referenced with tag numbers on diagram, indicating the following:
  - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
  - b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.

- c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
  - d. Generator thermal-damage curve.
  - e. Ratings, types, and settings of utility company's overcurrent protective devices.
  - f. Special overcurrent protective device settings or types stipulated by utility company.
  - g. Time-current-characteristic curves of devices indicated to be coordinated.
  - h. Manufacturer, frame size, interrupting rating in amperes root mean square (rms) symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
  - i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
  - j. Switchgear, switchboards, motor-control centers, and panelboards ampacity, and SCCR in amperes rms symmetrical.
  - k. Identify series-rated interrupting devices for condition where available fault current is greater than interrupting rating of downstream equipment. Obtain device data details to allow verification that series application of these devices complies with NFPA 70 and UL 489 requirements.
2. Examine the Project's overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance of the Work. Devices to be coordinated are indicated on Drawings.
3. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

C. Preparation of Data for Arc-Flash Hazard Study:

1. Assemble data from short-circuit study and overcurrent protective device coordination study.
2. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

### 3.3 SHORT-CIRCUIT STUDY

- A. Base study on device characteristics supplied by device manufacturer.
- B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for the Project. Study cases of system-switching configurations and alternate operations that could result in maximum fault conditions.
- C. Include AC fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase AC systems. Also account for fault-current DC decrement to address asymmetrical requirements of interrupting equipment.
- D. Calculate short-circuit momentary and interrupting duties for three-phase bolted fault and single line-to-ground fault at equipment indicated on one-line diagram.

1. For grounded systems, provide bolted line-to-ground fault-current study for areas as defined for three-phase bolted fault short-circuit study.
- E. Include in report identification of protective device applied outside its capacity.

### 3.4 OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

- A. Base study on device characteristics supplied by device manufacturer.
- B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for the Project. Study cases of system-switching configurations and alternate operations that could result in maximum fault conditions.
- C. Transformer Primary Overcurrent Protective Devices:
  1. Device must not operate in response to the following:
    - a. Inrush current when first energized.
    - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
    - c. Permissible transformer overloads in accordance with IEEE C57.96 if required by unusual loading or emergency conditions.
  2. Device settings must protect transformers in accordance with IEEE C57.12.00, for fault currents.
- D. Motor Protection:
  1. Select protection for low-voltage motors in accordance with IEEE 3004.8 and NFPA 70.
  2. Select protection for motors served at voltages more than 600 V in accordance with IEEE 620.
- E. Conductor Protection: Protect cables against damage from fault currents in accordance with ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 3004.7. Demonstrate that equipment withstands maximum short-circuit current for time equivalent to tripping time of primary relay protection or total clearing time of fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.
- F. Generator Protection: Select protection in accordance with manufacturer's published instructions and IEEE C37.102.
- G. Include AC fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase AC systems. Also account for fault-current DC decrement, to address asymmetrical requirements of interrupting equipment.
- H. Include coordination of ground-fault protection devices.
- I. Calculate short-circuit momentary and interrupting duties for three-phase bolted fault and single line-to-ground fault at equipment indicated on one-line diagram.

1. For grounded systems, provide bolted line-to-ground fault-current study for areas as defined for three-phase bolted fault short-circuit study.

J. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short-circuit ratings.
2. Adequacy of switchgear, motor-control centers, and panelboard bus bars to withstand short-circuit stresses.
3. Include in report identification of protective device applied outside its capacity.

3.5 LOAD-FLOW AND VOLTAGE-DROP STUDY

- A. Perform load-flow and voltage-drop study to determine steady-state loading profile of system. Analyze power system performance two times as follows:
1. Determine load flow and voltage drop based on full-load currents.
  2. Determine load flow and voltage drop based on 80 percent of design capacity of load buses.
  3. Prepare load-flow and voltage-drop analysis and report to show power system components that are overloaded, or might become overloaded; show bus voltages that are less than as prescribed by NFPA 70.

3.6 ARC-FLASH HAZARD STUDY

- A. Comply with NFPA 70E, including Annex D, for arc-flash hazard study.
- B. Preparatory Studies: Obtain short-circuit study and overcurrent protective device coordination study results prior to starting arc-flash hazard study.
- C. Calculate maximum and minimum contributions of fault-current size.
1. Maximum calculation must assume maximum contribution from utility and must assume motors to be operating under full-load conditions.
  2. Calculate arc-flash energy at 85 percent of maximum short-circuit current in accordance with IEEE 1584 recommendations.
  3. Calculate arc-flash energy at 38 percent of maximum short-circuit current in accordance with NFPA 70E recommendations.
  4. Calculate arc-flash energy with utility contribution at minimum and assume no motor contribution.
- D. Calculate arc-flash protection boundary and incident energy at locations in electrical distribution system where personnel could perform work on energized parts.
- E. Include medium- and low-voltage equipment locations.
- F. Calculate limited, restricted, and prohibited approach boundaries for each location.
- G. Incident energy calculations must consider accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations must account for

changing current contributions, as sources are interrupted or decremented with time. Fault contribution from motors and generators must be decremented as follows:

1. Fault contribution from induction motors must not be considered beyond three to five cycles.
  2. Fault contribution from synchronous motors and generators must be decayed to match actual decrement of each as closely as possible (for example, contributions from permanent magnet generators will typically decay from 10 p.u. to 3 p.u. after 10 cycles).
- H. Arc-flash energy must generally be reported for maximum of line or load side of circuit breaker. However, arc-flash computation must be performed and reported for both line and load side of circuit breaker as follows:
1. When circuit breaker is in separate enclosure.
  2. When line terminals of circuit breaker are separate from work location.
- I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

### 3.7 POWER SYSTEM STUDY REPORTS

- A. Preparation of Power System Study Reports: Prepare and submit the following:
1. Short-Circuit Study Report Contents:
    - a. Executive summary of study findings.
    - b. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
    - c. One-line diagram of modeled power system, showing the following:
      - 1) Protective device designations and ampere ratings.
      - 2) Conductor types, sizes, and lengths.
      - 3) Transformer kVA and voltage ratings.
      - 4) Motor and generator designations and kVA ratings.
      - 5) Switchgear, switchboard, motor-control center, and panelboard designations and ratings.
      - 6) Derating factors and environmental conditions.
      - 7) Revisions to electrical equipment required by study.
    - d. Comments and recommendations for system improvements or revisions in written document, separate from one-line diagram.
    - e. Short-Circuit Study Input Data:
      - 1) One-line diagram of system being studied.
      - 2) Power sources available.
      - 3) Manufacturer, model, and interrupting rating of protective devices.
      - 4) Conductors.
      - 5) Transformer data.
    - f. Protective Device Evaluation:

- 1) Evaluate equipment and protective devices and compare to available short-circuit currents. Verify that equipment withstand ratings exceed available short-circuit current at equipment installation locations.
- 2) Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
- 3) For 600 V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
- 4) For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in standards to 1/2-cycle symmetrical fault current.
- 5) Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

g. Short-Circuit Study Output Reports:

- 1) Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
  - a) Voltage.
  - b) Calculated fault-current magnitude and angle.
  - c) Fault-point X/R ratio.
  - d) Equivalent impedance.
- 2) Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
  - a) Voltage.
  - b) Calculated symmetrical fault-current magnitude and angle.
  - c) Fault-point X/R ratio.
  - d) Calculated asymmetrical fault currents based on fault-point X/R ratio; based on calculated symmetrical value multiplied by 1.6; and based on calculated symmetrical value multiplied by 2.7.
- 3) Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
  - a) Voltage.
  - b) Calculated symmetrical fault-current magnitude and angle.
  - c) Fault-point X/R ratio.
  - d) No AC Decrement (NACD) ratio.
  - e) Equivalent impedance.
  - f) Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on symmetrical basis.
  - g) Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on total basis.

2. Overcurrent Protection Device Coordination Study Report Contents:



- a. Executive summary of study findings.
- b. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- c. One-line diagram of modeled power system, showing the following:
  - 1) Protective device designations and ampere ratings.
  - 2) Conductor types, sizes, and lengths.
  - 3) Transformer kVA and voltage ratings.
  - 4) Motor and generator designations and kVA ratings.
  - 5) Switchgear, switchboard, motor-control center, and panelboard designations.
  - 6) Revisions to electrical equipment required by study.
- d. Report recommended settings of protective devices, ready to be applied in field. Use manufacturer's data sheets for recording recommended setting of overcurrent protective devices when available.
  - 1) Phase and Ground Relays:
    - a) Device tag.
    - b) Relay current transformer ratio and tap, time dial, and instantaneous pickup value.
    - c) Recommendations on improved relaying systems, if applicable.
  - 2) Circuit Breakers:
    - a) Adjustable pickups and time delays (long time, short time, and ground).
    - b) Adjustable time-current characteristic.
    - c) Adjustable instantaneous pickup.
    - d) Recommendations on improved trip systems, if applicable.
  - 3) Fuses: Show current rating, voltage, and class.
- e. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for switching schemes and for emergency periods where power source is local generation. Show the following information:
  - 1) Device tag and title, one-line diagram with legend identifying portion of system covered.
  - 2) Terminate device characteristic curves at point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.
  - 3) Identify device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
  - 4) Plot the following listed characteristic curves, as applicable:
    - a) Power utility's overcurrent protective device.
    - b) Medium-voltage equipment overcurrent relays.

- c) Medium- and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
    - d) Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
    - e) Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
    - f) Cables and conductors damage curves.
    - g) Ground-fault protective devices.
    - h) Motor-starting characteristics and motor damage points.
    - i) Generator short-circuit decrement curve and generator damage point.
    - j) Largest feeder circuit breaker in each motor-control center and panelboard.
  - 5) Maintain selectivity for tripping currents caused by overloads.
  - 6) Maintain maximum achievable selectivity for tripping currents caused by overloads on series-rated devices.
  - 7) Provide adequate time margins between device characteristics such that selective operation is achieved.
  - 8) Comments and recommendations for system improvements.
3. Arc-Flash Hazard Study Report Contents:
- a. Executive summary of study findings.
  - b. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
  - c. One-line diagram, showing the following:
    - 1) Protective device designations and ampere ratings.
    - 2) Conductor types, sizes, and lengths.
    - 3) Transformer kVA and voltage ratings, including derating factors and environmental conditions.
    - 4) Motor and generator designations and kVA ratings.
    - 5) Switchgear, switchboard, motor-control center, panelboard designations, and ratings.
  - d. Short-circuit study output data.
  - e. Overcurrent protective device coordination study report contents.
  - f. Arc-Flash Study Output Reports:
    - 1) Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each equipment location included in report:
      - a) Voltage.
      - b) Calculated symmetrical fault-current magnitude and angle.
      - c) Fault-point X/R ratio.
      - d) No AC Decrement (NACD) ratio.
      - e) Equivalent impedance.
      - f) Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on symmetrical basis.
      - g) Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on total basis.

g. Incident Energy and Flash Protection Boundary Calculations:

- 1) Arcing fault magnitude.
- 2) Protective device clearing time.
- 3) Duration of arc.
- 4) Arc-flash boundary.
- 5) Restricted approach boundary.
- 6) Limited approach boundary.
- 7) Working distance.
- 8) Incident energy.
- 9) Hazard risk category.
- 10) Recommendations for arc-flash energy reduction.

h. Fault study input data, case descriptions, and fault-current calculations including definition of terms and guide for interpretation of computer printout.

3.8 FIELD ADJUSTMENT FOR DEVICE COORDINATION

- A. Adjust relay and protective device settings in accordance with recommended settings provided by coordination study. Field adjustments must be completed by engineering service division of equipment manufacturer under "Startup and Acceptance Testing" contract portion.
- B. Make minor modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.
- C. Testing and adjusting must be by qualified low-voltage electrical testing and inspecting agency.
  1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters. Perform NETA tests and inspections for adjustable overcurrent protective devices.

3.9 WARNING LABELING OF ARC-FLASH HAZARDS

- A. Apply one arc-flash label on front cover of each section of equipment for each equipment included in study, including each piece of equipment listed below:
  1. Medium-voltage switchgear.
  2. Medium-voltage switches.
  3. Medium voltage transformers.
  4. Low-voltage switchgear.
  5. Switchboards.
  6. Panelboards.
  7. Motor-control centers.
  8. Low voltage transformers.
  9. Safety switches.
  10. Control panels.
- B. Base arc-flash label data on highest values calculated at each location.

- C. Machine print warning labels with no handwritten or field-applied markings.
- D. Install arc-flash warning labels under direct supervision and control of qualified electrical professional engineer.
- E. Indicate on record Drawings location of equipment where personnel could be exposed to arc-flash hazard during their work.
  - 1. Indicate arc-flash energy.
  - 2. Indicate protection level required.

END OF SECTION 260573

## SECTION 260800 - COMMISSIONING OF ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Electrical equipment connected to Normal electrical systems, including the following:
  - a. Motor-control centers.
  - b. Transformers.
  - c. **Primary and secondary** service electrical systems.
  - d. **Distribution and branch-circuit** panelboards.
  - e. Grounding systems.
2. Electrical equipment connected to Essential electrical systems that provide an alternative source of power in the absence of power from the Normal electrical system, including the following:
  - a. **Primary and secondary** service electrical systems.
  - b. **Distribution and branch-circuit** panelboards.
  - c. Grounding systems.
  - d. Generators.
3. Controls and instrumentation, including the following:
  - a. Equipment monitoring systems.
  - b. Energy monitoring and control systems.
  - c. Electrical metering and metering system.
  - d. Lighting control systems.
  - e. Fire-alarm systems.
4. Systems testing and verification, including Normal and Essential electrical systems, and transitions from Normal to Essential electrical systems and back.

##### B. Related Requirements:

1. Section 019113 "General Commissioning Requirements" for general Cx process requirements and CxA responsibilities.
2. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
3. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

## 1.2 DEFINITIONS

- A. BoD: Basis-of-Design Document, as defined in Section 019113 "General Commissioning Requirements."
- B. Cx: Commissioning, as defined in Section 019113 "General Commissioning Requirements."
- C. CxA: Commissioning Authority, as defined in Section 019113 "General Commissioning Requirements."
- D. OPR: Owner's Project Requirements, as defined in Section 019113 "General Commissioning Requirements."
- E. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they mean "as-built" systems, assemblies, subsystems, equipment, and components.

## 1.3 INFORMATIONAL SUBMITTALS

- A. Construction Checklists by CxA: Draft construction checklists will be created by CxA for Contractor review.
- B. Construction Checklists by Contractor: Include the following and comply with requirements in Section 019113 "General Commissioning Requirements" for construction checklists:
  - 1. Instrumentation and control for electrical systems.
  - 2. Instrumentation and control for lighting control systems.
  - 3. Low-voltage power cables.
  - 4. Control voltage power cables.
  - 5. Electrical feeders and branch circuits.
  - 6. Dry-type transformers.
  - 7. Switchgear and switchboard assemblies rated 1200 A or greater.
  - 8. Low-voltage motor starters.
  - 9. Low-voltage insulated case circuit breakers.
  - 10. Low-voltage surge protective devices.
  - 11. Protective relays.
  - 12. Metering devices.
  - 13. Molded-case circuit breakers.
  - 14. Low-voltage power circuit breakers.
  - 15. Grounding systems.
  - 16. Ground-fault protection systems.
  - 17. Panelboards.
  - 18. Receptacles and devices.
  - 19. Engine generators.
  - 20. Automatic transfer switches.
  - 21. Variable-frequency drives.
  - 22. AC synchronous motors and generators.
  - 23. AC induction motors and generators.
  - 24. Battery systems.
  - 25. Battery chargers.

26. Flooded lead-acid batteries.
27. VRLA batteries.
28. Lighting.
29. Vehicle charging equipment.

#### 1.4 QUALITY ASSURANCE

A. Testing Equipment and Instrumentation Quality and Calibration: For test equipment and instrumentation required to perform electrical Cx work, perform the following:

1. Submit test equipment and instrumentation list. For each equipment or instrument, identify the following:
  - a. Equipment/instrument identification number.
  - b. Planned Cx application or use.
  - c. Manufacturer, make, model, and serial number.
  - d. Calibration history, including certificates from agencies that calibrate the equipment and instrumentation.
2. Test equipment and instrumentation must meet the following criteria:
  - a. Capable of testing and measuring performance within the specified acceptance criteria.
  - b. Be calibrated at manufacturer's recommended intervals with current calibration tags permanently affixed to the instrument being used.
  - c. Be maintained in good repair and operating condition throughout duration of use on Project.
  - d. Be recalibrated/repared if dropped or damaged in any way since last calibrated.

B. Proprietary Test Instrumentation and Tools:

1. Equipment Manufacturer's Proprietary Instrumentation and Tools: For installed equipment included in the Cx process, test instrumentation and tools manufactured or prescribed by equipment manufacturer to service, calibrate, adjust, repair, or otherwise work on its equipment or required as a condition of equipment warranty, perform the following:
  - a. Submit proprietary instrumentation and tools list. For each instrument or tool, identify the following:
    - 1) Instrument or tool identification number.
    - 2) Equipment schedule designation of equipment for which the instrument or tool is required.
    - 3) Manufacturer, make, model, and serial number.
    - 4) Calibration history, including certificates from agencies that calibrate the instrument or tool, where appropriate.
  - b. Include a separate list of proprietary test instrumentation and tools in operation and maintenance manuals.

- c. Electrical proprietary test instrumentation and tools become property of Owner at the time of Substantial Completion.

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 CONSTRUCTION CHECKLISTS

### 3.2 CONSTRUCTION CHECKLIST REVIEW

- A. Review and provide written comments on draft construction checklists. CxA will create required draft construction checklists and provide them to Contractor.
- B. Return draft Construction Checklist review comments within 10 days of receipt.
- C. When review comments have been resolved, CxA will provide final construction checklists, marked "Approved for Use, (date)."
- D. Use only construction checklists, marked "Approved for Use, (date)."

### 3.3 GENERAL TESTING REQUIREMENTS

- A. Certify that electrical systems, subsystems, and equipment have been installed, calibrated, and started and that they are operating according to the Contract Documents and approved Shop Drawings and submittals.
- B. Certify that electrical instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents and approved Shop Drawings and submittals, and that pretest set points have been recorded.
- C. Set systems, subsystems, and equipment into operating mode to be tested according to approved test procedures (for example, normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- D. Measure capacities and effectiveness of systems, assemblies, subsystems, equipment, and components, including operational and control functions to verify compliance with acceptance criteria.
- E. Test systems, assemblies, subsystems, equipment, and components operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and response according to acceptance criteria.
- F. Construction Checklists: Prepare and submit detailed construction checklists for electrical systems, subsystems, equipment, and components.



1. Contributors to development of construction checklists must include, but are not limited to, the following:
    - a. Electrical systems and equipment installers.
    - b. Electrical instrumentation and controls installers.
  - G. Perform tests using design conditions, whenever possible.
    1. Simulated conditions may, with approval of Architect, be imposed using an artificial load when it is impractical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by CxA, and document simulated conditions and methods of simulation. After tests, return configurations and settings to normal operating conditions.
    2. Cx test procedures may direct that set points be altered when simulating conditions is impractical.
    3. Cx test procedures may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are impractical.
  - H. If tests cannot be completed because of a deficiency outside the scope of the electrical system, document the deficiency and report it to Owner. After deficiencies are resolved, reschedule tests.
  - I. If seasonal testing is specified, complete appropriate initial performance tests and documentation and schedule seasonal tests.
  - J. Coordinate schedule with, and perform Cx activities at the direction of the CxA.
  - K. Comply with Construction Checklist requirements, including material verification, installation checks, startup, and performance tests requirements specified in Sections specifying electrical systems and equipment.
  - L. Provide qualified testing and inspecting agency personnel in accordance with Section 260010 "Supplemental Requirements for Electrical," instrumentation, tools, and equipment to complete and document the following:
    1. Performance tests.
    2. Demonstration of a sample of performance tests.
    3. Cx tests.
    4. Cx test demonstrations.
- 3.4 Cx TESTS FOR ELECTRICAL SYSTEMS
- A. Verification of Normal Electrical System Operation:
1. Prerequisites: Acceptance of results for construction checklists for Division 26 electrical components associated with Normal electrical system.
  2. Equipment and Systems to Be Tested: Division 26 electrical equipment.
  3. Test Purpose: Verify operation of Normal electrical system.
  4. Test Conditions: Energize components of Normal electrical system, one at a time.
  5. Acceptance Criteria: Proper operation of Normal electrical system over a 48 hour period.

B. Verification of Essential Electrical System Operation:

1. Prerequisites:
  - a. Acceptance of results for construction checklists for Division 26 electrical components associated with Essential electrical system.
  - b. Completion of "Verification of Normal Electrical System Operation" tests.
2. Equipment and Systems to Be Tested: Division 26 electrical equipment.
3. Test Purpose: Verify operation of Essential electrical system.
4. Test Conditions:
  - a. Energize components of Normal electrical system.
  - b. Simulate a failure of Normal electrical system.
5. Acceptance Criteria: Transfer of power from Normal to Essential electrical system within OPR.

C. Verification of Control and Instrumentation:

1. Prerequisites: Acceptance of results for construction checklists.
  - a. Section 260913 "Electrical Power Monitoring and Control."
  - b. Section 260926 "Lighting Control Panelboards."
  - c. Section 260936 "Modular Dimming Controls."
  - d. Section 260943.16 "Addressable-Luminaire Lighting Controls."
  - e. Section 260943.23 "Relay-Based Lighting Controls."
  - f. Section 262713 "Electricity Metering."
  - g. Section 263533 "Power Factor Correction Equipment."

D. Test Purpose: Verify operation of control and monitoring systems for Normal and Essential electrical systems.

E. Test Conditions:

1. Energize components of Normal electrical system.
2. Test operation of equipment.

F. Acceptance Criteria: Operation of equipment according to OPR.

END OF SECTION 260800

## SECTION 260923 - LIGHTING CONTROL DEVICES

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Electronic time switch control panel
2. Outdoor photoelectric switches, low voltage.
3. Daylight-harvesting dimming controls, analog.
4. Daylight-harvesting dimming controls, digital.
5. Indoor occupancy and vacancy sensors.
6. Switchbox-mounted occupancy sensors.
7. Conductors and cables.

##### B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
3. Section 262726 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

#### 1.2 ACTION SUBMITTALS

##### A. Product Data:

1. Electronic time switch control panel
2. Outdoor photoelectric switches, low voltage.
3. Daylight-harvesting dimming controls, analog.
4. Daylight-harvesting dimming controls, digital.
5. Indoor occupancy and vacancy sensors.
6. Switchbox-mounted occupancy sensors.
7. Conductors and cables.

##### B. Shop Drawings:

1. Show installation details for the following:
  - a. Occupancy sensors.
  - b. Vacancy sensors.
2. Interconnection diagrams showing field-installed wiring.
3. Include diagrams for power, signal, and control wiring.

- C. Field quality-control reports.

### 1.3 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For manufacturer's warranties.

### 1.4 WARRANTY

- A. Special Extended Warranty: Manufacturer and Installer warrant that installed lighting control devices perform in accordance with specified requirements and agree to repair or replace, including labor, materials, and equipment, devices that fail to perform as specified within extended warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Faulty operation of lighting control software.
    - b. Faulty operation of lighting control devices.
  - 2. Extended Warranty Period: Two year(s) from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 ELECTRONIC TIME SWITCH CONTROL PANEL

- A. Basis of Design: Wattstopper LP8 or engineer approved equal.
- B. Electronic Time Switch control panel: Solid state, programmable, with alphanumeric display; complying with UL 917.
  - 1. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
  - 2. Contact Configuration: SPST.
  - 3. Contact Rating: 30 A inductive or resistive.
  - 4. Programs:
    - a. 4 channels; each channel is individually programmable with 40 on-off operations per week and an annual holiday schedule that overrides the weekly operation on holidays.
  - 5. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.
  - 6. Astronomic Time: **All** channels.
  - 7. Automatic daylight savings time changeover.
  - 8. Battery Backup and Non-volatile memory, to maintain schedules and time clock.

## 2.2 OUTDOOR PHOTOELECTRIC SWITCHES, LOW VOLTAGE

- A. Description: Solid state; one set of NO dry contacts rated for 24 V(dc) at 1 A, to operate connected load, complying with UL 773, and compatible with lighting control panelboard.
  - 1. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
  - 2. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lx), with an adjustment for turn-on and turn-off levels within that range.
  - 3. Time Delay: Thirty-second minimum, to prevent false operation.
  - 4. Mounting: 1/2 inch (13 mm) threaded male conduit.
  - 5. Failure Mode: Luminaire stays ON.

## 2.3 DAYLIGHT-HARVESTING DIMMING CONTROLS, ANALOG

- A. Description: Sensing daylight and electrical lighting levels, the system adjusts the indoor electrical lighting levels. As daylight increases, the lights are dimmed.
  - 1. Lighting control set point is based on two lighting conditions:
    - a. When no daylight is present (target level).
    - b. When significant daylight is present.
  - 2. System programming is done with two hand-held, remote-control tools.
    - a. Initial setup tool.
    - b. Tool for occupants to adjust the target levels by increasing the set point up to 25 percent, or by minimizing the electric lighting level.
- B. Ceiling-Mounted Dimming Controls: Solid-state, light-level sensor unit, with integrated power pack, to detect changes in indoor lighting levels that are perceived by the eye.
- C. Electrical Components, Devices, and Accessories:
  - 1. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
  - 2. Sensor Output: zero to 10 V(dc) to operate luminaires. Sensor is powered by controller unit.
  - 3. Light-Level Sensor Set-Point Adjustment Range: 20 to 60 fc (120 to 640 lx).

## 2.4 DAYLIGHT-HARVESTING DIMMING CONTROLS, DIGITAL

- A. Description: Sensing daylight and electrical lighting levels, the system adjusts the indoor electrical lighting levels. As daylight increases, lights are dimmed.
  - 1. Lighting control set point is based on the following two lighting conditions:

- a. When no daylight is present (target level).
  - b. When significant daylight is present.
2. System programming is done with two hand-held, remote-control tools.
  - a. Initial setup tool.
  - b. Tool for occupants to adjust the target levels by increasing the set point up to 25 percent, or by minimizing the electric lighting level.
- B. Ceiling-Mounted Dimming Controls: Solid-state, light-level sensor unit, to detect changes in indoor lighting levels that are perceived by the eye.
- C. Electrical Components, Devices, and Accessories:
  1. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
  2. Sensor Output: zero to 10 V(dc) to operate luminaires. Sensor is powered by controller unit.
  3. Light-Level Sensor Set-Point Adjustment Range: 20 to 60 fc (120 to 640 lx).
  4. With integral current monitoring.
  5. Compatible with digital addressable lighting interface.
  6. Plenum rated.

## 2.5 INDOOR OCCUPANCY AND VACANCY SENSORS

- A. Basis of Design: Wattstopper
  1. DLM with room controller for larger areas requiring multiple control functions.
  2. Coordinating standalone low voltage for small rooms requiring simple functionality.
- B. General Requirements for Sensors:
  1. Ceiling-mounted, solid-state indoor occupancy and vacancy sensors.
  2. Dual technology.
  3. Separate power pack.
  4. Hardwired connection to switch and/or lighting control system.
  5. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
  6. Operation:
    - a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
    - b. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
    - c. Combination Sensor: Unless otherwise indicated, sensor must be programmed to turn lights on when coverage area is occupied and turn them off when unoccupied,

or to turn off lights that have been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

7. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A
  8. Sensor is powered from the power pack or room controller.
  9. Power Pack: Dry contacts rated for minimum 20 A LED load at 120 and 277 V(ac), for 13 A tungsten at 120 V(ac), and for 1 hp at 120 V(ac). Sensor has 24 V(dc), 150 mA, Class 2 power source.
  10. Mounting:
    - a. Sensor: Suitable for mounting in any position in a standard device box or outlet box.
    - b. Relay: Externally mounted through a 1/2 inch (13 mm) knockout in a standard electrical enclosure.
    - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
  11. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
  12. Bypass Switch: Override the "on" function in case of sensor failure.
- C. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
  2. Detector Sensitivity: Detect occurrences of 6 inch (150 mm) minimum movement of any portion of a human body that presents a target of not less than 36 sq. inch (23 200 sq. mm), and detect a person of average size and weight moving not less than 12 inch (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inch/s (305 mm/s).
  3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96 inch (2440 mm) high ceiling.

## 2.6 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

- A. Basis of Design: Wattstopper
- B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor with manual on-off switch, suitable for mounting in a single gang switchbox using hardwired connection.
1. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
  2. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
  3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F (0 to 49 deg C).
  4. Switch Rating: Not less than 800 VA LED load at 120 V.

C. Wall-Switch Sensor:

1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft.
2. Sensing Technology: PIR.
3. Switch Type: SP, field-selectable automatic "on," or manual "on," automatic "off."
4. Capable of controlling load in three-way application.
5. Voltage: Match the circuit voltage.
6. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
7. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.
8. Color: White.
9. Faceplate: Color matched to switch.

2.7 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.
- B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF SENSORS

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.



- B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's instructions.

### 3.3 INSTALLATION OF WIRING

- A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch (13 mm).
- B. Wiring within Enclosures: Separate power-limited and nonpower-limited conductors in accordance with conductor manufacturer's instructions.
- C. Size conductors in accordance with lighting control device manufacturer's instructions unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, device, and outlet boxes; terminal cabinets; and equipment enclosures.

### 3.4 IDENTIFICATION

- A. Identify components and power and control wiring in accordance with Section 260553 "Identification for Electrical Systems."
  - 1. Identify controlled circuits in lighting contactors.
  - 2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

### 3.5 FIELD QUALITY CONTROL

- A. Field tests must be witnessed by Architect.
- B. Tests and Inspections:
  - 1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Nonconforming Work:
  - 1. Lighting control devices will be considered defective if they do not pass tests and inspections.
  - 2. Remove and replace defective units and retest.
- D. Manufacturer Services:
  - 1. Engage factory-authorized service representative to support field tests and inspections.

3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
  - 1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
  - 2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.

END OF SECTION 260923

## SECTION 262413 - SWITCHBOARDS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Switchboards.
2. Surge protection devices.
3. Disconnecting and overcurrent protective devices.
4. Instrumentation.
5. Control power.
6. Accessory components and features.

##### B. Related Requirements

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
3. Section 260573.19 "Arc-Flash Hazard Analysis" for arc-flash analysis and arc-flash label requirements.

#### 1.2 COORDINATION

- A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided.

#### 1.3 ACTION SUBMITTALS

##### A. Product Data:

1. Switchboards.
2. Overcurrent protective devices.
3. Surge protection devices.
4. Ground-fault protection devices.
5. Accessories.
6. Other components.

7. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
- B. Shop Drawings: For each switchboard and related equipment.
1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
  2. Detail enclosure types for types other than UL 50E, Type 1.
  3. Detail bus configuration, current, and voltage ratings.
  4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
  5. Detail utility company's metering provisions with indication of approval by utility company.
  6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
  7. Include schematic and wiring diagrams for power, signal, and control wiring.
- C. Field Quality-Control Submittals:
1. Field Quality-Control Reports:
    - a. Test procedures used.
    - b. Test results that comply with requirements.
    - c. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- 1.4 DELIVERY, STORAGE, AND HANDLING
- A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.
  - B. Remove loose packing and flammable materials from inside switchboards and install temporary electric heating to prevent condensation.
  - C. Handle and prepare switchboards for installation in accordance with NEMA PB 2.1.
- 1.5 WARRANTY
- A. Special Installer Extended Warranty: Installer warrants that fabricated and installed switchboard perform in accordance with specified requirements and agrees to repair or replace components that fail to perform as specified within extended-warranty period.
    1. Extended-Warranty Period: Two years from date of Substantial Completion; full coverage for labor, materials, and equipment.

## PART 2 - PRODUCTS

### 2.1 SWITCHBOARDS

- A. Basis of Design: Square-D
- B. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
- D. Comply with NEMA PB 2.
- E. Comply with NFPA 70.
- F. Comply with UL 891.
- G. Front-Connected, Front-Accessible Switchboards:
  - 1. Main Devices: Fixed, individually mounted.
  - 2. Branch Devices: Panel mounted.
  - 3. Sections front and rear aligned.
- H. Indoor Enclosures: Steel, UL 50E, Type 1.
- I. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over rust-inhibiting primer on treated metal surface.
- J. Outdoor Enclosures: Type 3R.
  - 1. Finish: Factory-applied finish in manufacturer's standard color; undersurfaces treated with corrosion-resistant undercoating.
  - 2. Enclosure: Downward, rearward sloping roof; hinged doors for each section, with provisions for padlocking.
- K. Barriers: Between adjacent switchboard sections.
- L. Strip Heaters: Factory-installed electric strip heaters of sufficient wattage in each vertical section to maintain enclosure temperature above expected dew point.
  - 1. Space-Heater Control: Thermostats to maintain temperature of each section above expected dew point
- M. Service Entrance Rating: Switchboards intended for use as service entrance equipment may contain from one to six service disconnecting means with overcurrent protection, neutral bus with disconnecting link, grounding electrode conductor terminal, and main bonding jumper.
- N. Utility Metering Compartment: Barrier compartment and section complying with utility company's requirements; hinged sealable door; buses provisioned for mounting utility

company's current transformers and potential transformers or potential taps as required by utility company. If separate vertical section is required for utility metering, match and align with basic switchboard. Provide service entrance label and necessary applicable service entrance features.

- O. Buses and Connections: Three phase, four wire unless otherwise indicated.
  - 1. Provide phase bus arrangement A, B, C from front to back, top to bottom, and left to right when viewed from front of switchboard.
  - 2. Phase- and Neutral-Bus Material:
    - a. Hard-drawn copper of 98 percent conductivity, silver-plated.
  - 3. Copper feeder circuit-breaker line connections.
  - 4. Ground Bus: hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors.
  - 5. Main-Phase Buses and Equipment-Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
  - 6. Disconnect Links:
    - a. Isolate neutral bus from incoming neutral conductors.
    - b. Bond neutral bus to equipment-ground bus for switchboards utilized as service equipment or separately derived systems.
  - 7. Neutral Buses: 100 percent of ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.

## 2.2 SURGE PROTECTION DEVICES

- A. SPDs: Listed and labeled in accordance with UL 1449, Type 2.
- B. Features and Accessories:
  - 1. Internal thermal protection that disconnects SPD before damaging internal suppressor components.
  - 2. Indicator light display for protection status.
  - 3. Surge counter.
- C. Peak Surge Current Rating: Minimum single-pulse surge current withstand rating per phase may not be less than 200 kA. Peak surge current rating must be arithmetic sum of ratings of individual MOVs in each mode.
- D. Protection modes and UL 1449 VPR for grounded wye circuits with 208Y/120 V, three-phase, four-wire circuits may not exceed the following:
  - 1. Line to Neutral: 700 V for 208Y/120 V.
  - 2. Line to Ground: 1200 V for 208Y/120 V.
  - 3. Line to Line: 1000 V for 208Y/120 V.
- E. SCCR: Equal or exceed 100 kA.

## 2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with **interrupting capacity** to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  3. Electronic trip circuit breakers with RMS sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
    - a. Instantaneous trip.
    - b. Long- and short-time pickup levels.
    - c. Long and short time adjustments.
    - d. Ground-fault pickup level, time delay, and I squared t response.
  4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
  5. MCCB Features and Accessories:
    - a. Standard frame sizes, trip ratings, and number of poles.
    - b. Lugs: Suitable for number, size, trip ratings, and conductor material.
    - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
    - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
- B. Insulated-Case Circuit Breaker (ICCB): 80 percent rated, sealed, insulated-case power circuit breaker with interrupting capacity rating to meet available fault current.
1. Fixed circuit-breaker mounting.
  2. Two-step, stored-energy closing.
  3. Full-function, microprocessor-based trip units with interchangeable rating plug, trip indicators, and the following field-adjustable settings:
    - a. Instantaneous trip.
    - b. Time adjustments for long- and short-time pickup.
    - c. Ground-fault pickup level, time delay, and I squared t response.
  4. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
  5. Remote trip indication and control.
  6. Communication Capability: Web enabled integral Ethernet communication module and embedded Web server with factory-configured Web pages (HTML file format). Provide functions and features compatible with power monitoring and control system specified in Section 260913 "Electrical Power Monitoring and Control."

## 2.4 INSTRUMENTATION

- A. Instrument Transformers: NEMA EI 21.1, and the following:
  - 1. Current Transformers: NEMA EI 21.1; 5 A, 60 Hz, secondary. Burden and accuracy must be consistent with connected metering and relay devices.
  - 2. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondary wiring to ground overcurrent relays, via shorting terminals, to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker, ground-fault protection.
- B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
  - 1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
    - a. Phase Currents, Each Phase: Plus or minus 0.5 percent.
    - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 0.5 percent.
    - c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 0.5 percent.
    - d. Megawatts: Plus or minus 1 percent.
    - e. Megavars: Plus or minus 1 percent.
    - f. Power Factor: Plus or minus 1 percent.
    - g. Frequency: Plus or minus 0.1 percent.
    - h. Accumulated Energy, Megawatt Hours: Plus or minus 1 percent; accumulated values unaffected by power outages up to 72 hours.
    - i. Megawatt Demand: Plus or minus 1 percent; demand interval programmable from five to 60 minutes.
  - 2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

## 2.5 CONTROL POWER

- A. Control Circuits:
  - 1. 120 V(ac), supplied through secondary disconnecting devices from control-power transformer.

## 2.6 ACCESSORY COMPONENTS AND FEATURES

- A. Mounting Accessories: For anchors, mounting channels, bolts, washers, and other mounting accessories, comply with requirements in Section 260548.16 "Seismic Controls for Electrical Systems" or manufacturer's instructions.



## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Receive, inspect, handle, and store switchboards in accordance with NEMA PB 2.1.
  - 1. Lift or move panelboards with spreader bars and manufacturer-supplied lifting straps following manufacturer's published instructions.
  - 2. Use rollers, slings, or other manufacturer-approved methods if lifting straps are not furnished.
  - 3. Protect from moisture, dust, dirt, and debris during storage and installation.
  - 4. Install temporary heating during storage in accordance with manufacturer's published instructions.
- B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.
- C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work or that affect performance of equipment.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with manufacturer's published instructions.
- B. Reference Standards:
  - 1. Switchboards and Accessories: Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NEMA PB 2.1.
  - 2. Consult Architect for resolution of conflicting requirements.
- C. Special Techniques:
  - 1. Equipment Mounting: Install switchboards on concrete base, 4 inch (100 mm) nominal thickness. Comply with requirements for concrete base specified in Section 260529 "Hangers and Supports for Electrical Systems."
    - a. Install conduits entering underneath switchboard, entering under vertical section where conductors will terminate. Install with couplings flush with concrete base. Extend 2 inch (50 mm) above concrete base after switchboard is anchored in place.
    - b. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18 inch (450 mm) centers around full perimeter of concrete base.
    - c. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

- d. Place and secure anchorage devices. Use setting drawings, templates, diagrams, published instructions, and directions furnished with items to be embedded.
  - e. Install anchor bolts to elevations required for proper attachment to switchboards.
  - f. Anchor switchboard to building structure at top of switchboard if required or recommended by manufacturer.
- 2. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, straps and brackets, and temporary blocking of moving parts from switchboard units and components.
  - 3. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
  - 4. Install filler plates in unused spaces of panel-mounted sections.
  - 5. Install overcurrent protective devices, surge protection devices, and instrumentation.
    - a. Set field-adjustable switches and circuit-breaker trip ranges.

### 3.3 CONNECTIONS

- A. Bond conduits entering underneath switchboard to equipment ground bus with bonding conductor sized in accordance with NFPA 70.
- B. Support and secure conductors within switchboard in accordance with NFPA 70.
- C. Extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.

### 3.4 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Switchboard Nameplates: Label each switchboard compartment with nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Service Equipment Label: Labeled, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

### 3.5 FIELD QUALITY CONTROL

- A. Field tests and inspections must be witnessed by **Architect**.

B. Tests and Inspections:

1. Acceptance Testing:

- a. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit. Open control and metering circuits within switchboard, and remove neutral connection to surge protection and other electronic devices prior to insulation test. Reconnect after test.
  - b. Test continuity of each circuit.
2. Test ground-fault protection of equipment for service equipment in accordance with NFPA 70.
  3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  4. Correct malfunctioning units on-site where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  5. Perform the following infrared scan tests and inspections, and prepare reports:
    - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform infrared scan of each switchboard. Remove front panels so joints and connections are accessible to portable scanner.
    - b. Follow-up Infrared Scanning: Perform additional follow-up infrared scan of each switchboard 11 months after date of Substantial Completion.
    - c. Instruments and Equipment:
      - 1) Use infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
  6. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

C. Nonconforming Work:

1. Switchboard will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

D. Collect, assemble, and submit test and inspection reports, including certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

E. Manufacturer Services:

1. Engage factory-authorized service representative to support field tests and inspections.

3.6 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Coordination Studies."

### 3.7 PROTECTION

- A. Temporary Heating: Apply temporary heat, to maintain temperature in accordance with manufacturer's published instructions, until switchboard is ready to be energized and placed into service.

END OF SECTION 262413

## SECTION 262416 - PANELBOARDS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Power panelboards.
2. Lighting and appliance branch-circuit panelboards.
3. Disconnecting and overcurrent protective devices.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

#### 1.2 DEFINITIONS

- A. GFEP: Ground-fault equipment protection.
- B. MCCB: Molded-case circuit breaker.
- C. VPR: Voltage protection rating.

#### 1.3 ACTION SUBMITTALS

A. Product Data:

1. Power panelboards.
2. Lighting and appliance branch-circuit panelboards.
3. Disconnecting and overcurrent protective devices.
4. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
5. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.

3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.
5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Include evidence of listing, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for SPD as installed in panelboard.
7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
8. Include wiring diagrams for power, signal, and control wiring.

C. Field Quality-Control Submittals:

1. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

- A. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating to prevent condensation.
- B. Handle and prepare panelboards for installation in accordance with NEMA PB 1.

1.6 WARRANTY

- A. Special Installer Extended Warranty: Installer warrants that fabricated and installed panelboards perform in accordance with specified requirements and agrees to repair or replace components or products that fail to perform as specified within extended-warranty period.
1. Extended-Warranty Period: Two years from date of Substantial Completion; full coverage for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 PANELBOARDS COMMON REQUIREMENTS

- A. Fabricate and test panelboards in accordance with IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."
- B. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing agency recognized by authorities having jurisdiction, and marked for intended location and application.
- C. Comply with NEMA PB 1.

- D. Comply with NFPA 70.
- E. Enclosures: Flush and Surface-mounted (see plans), dead-front cabinets.
  - 1. Rated for environmental conditions at installed location.
    - a. Indoor Dry and Clean Locations: UL 50E, Type 1.
    - b. Outdoor Locations: UL 50E, Type 3R.
    - c. Other Wet or Damp Indoor Locations: UL 50E, Type 4.
  - 2. Height: 7 ft (2.13 m) maximum.
  - 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims must cover live parts and may have no exposed hardware.
  - 4. Finishes:
    - a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    - b. Back Boxes: Galvanized steel.
- F. Incoming Mains:
  - 1. Location: Convertible between top and bottom.
  - 2. Main Breaker: Main lug interiors up to 400 A must be field convertible to main breaker.
- G. Phase, Neutral, and Ground Buses:
  - 1. Material: Hard-drawn copper, 98 percent conductivity.
    - a. Plating must run entire length of bus.
    - b. Bus must be fully rated for entire length.
  - 2. Interiors must be factory assembled into unit. Replacing switching and protective devices may not disturb adjacent units or require removing main bus connectors.
  - 3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
  - 4. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure.
  - 5. Do not mount neutral bus in gutter.
- H. Conductor Connectors: Suitable for use with conductor material and sizes.
  - 1. Material: Tin-plated aluminum or Hard-drawn copper, 98 percent conductivity.
  - 2. Terminations must allow use of 75 deg C rated conductors without derating.
  - 3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
  - 4. Main and Neutral Lugs: Mechanical type, with lug on neutral bar for each pole in panelboard.
  - 5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with lug on bar for each pole in panelboard.

6. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
- I. Quality-Control Label: Panelboards or load centers must be labeled, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers must have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.
- J. Future Devices: Panelboards or load centers must have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
  1. Percentage of Future Space Capacity: 10 percent minimum.
- K. Panelboard Short-Circuit Current Rating:
  1. Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for 100 percent interrupting capacity.
    - a. Panelboards and overcurrent protective devices rated 240 V or less must have short-circuit ratings as shown on Drawings, but not less than 10 000 A(rms) symmetrical.
    - b. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V must have short-circuit ratings as shown on Drawings, but not less than 14 000 A(rms) symmetrical.
- L. Surge Suppression: Factory installed as integral part of indicated panelboards, complying with UL 1449 SPD Type 2.

## 2.2 POWER PANELBOARDS

- A. Listing Criteria: NEMA PB 1, distribution type.
- B. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
  1. For doors more than 36 inch high, provide two latches, keyed alike.
- C. Mains: Circuit breaker or Lugs only; see plans and panel schedules for types used.

## 2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Listing Criteria: NEMA PB 1, lighting and appliance branch-circuit type.
- B. Mains: Circuit breaker or Lugs only; see plans and panel schedules for types used.
- C. Branch Overcurrent Protective Devices: Plug-in or Bolt-on circuit breakers, replaceable without disturbing adjacent units.



- D. Doors: Door-in-door construction with concealed hinges; secured with latch with tumbler lock; keyed alike.

## 2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.

- 1. Thermal-Magnetic Circuit Breakers:

- a. Inverse time-current element for low-level overloads.
- b. Instantaneous magnetic trip element for short circuits.
- c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

- 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

- 3. Electronic Trip Circuit Breakers:

- a. RMS sensing.
- b. Field-replaceable rating plug or electronic trip.
- c. Digital display of settings, trip targets, and indicated metering displays.
- d. Multi-button keypad to access programmable functions and monitored data.
- e. Ten-event, trip-history log. Each trip event must be recorded with type, phase, and magnitude of fault that caused trip.
- f. Integral test jack for connection to portable test set or laptop computer.
- g. Field-Adjustable Settings:
  - 1) Instantaneous trip.
  - 2) Long- and short-time pickup levels.
  - 3) Long and short time adjustments.
  - 4) Ground-fault pickup level, time delay, and I squared T response.

- 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.

- 5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6 mA trip).

- 6. GFEP Circuit Breakers: Class B ground-fault protection (30 mA trip).

- 7. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240 V, single-pole configuration.

- 8. Subfeed Circuit Breakers: Vertically mounted.

- 9. MCCB Features and Accessories:

- a. Standard frame sizes, trip ratings, and number of poles.
- b. Breaker handle indicates tripped status.
- c. UL listed for reverse connection without restrictive line or load ratings.
- d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
- e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.

- f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
- g. Communication Capability: Integral communication module with functions and features compatible with power monitoring and control system specified in Section 260913 "Electrical Power Monitoring and Control."
- h. Shunt Trip: 120 V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
- i. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in off position.
- j. Rating Plugs: Three-pole breakers with ampere ratings greater than 150A must have interchangeable rating plugs or electronic adjustable trip units.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.
- B. Receive, inspect, handle, and store panelboards in accordance with NEMA PB 1.1.
- C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.
- D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Comply with manufacturer's published instructions.
- B. Reference Standards:
  - 1. Panelboards: Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NEMA PB 1.1.
  - 2. Consult Architect for resolution of conflicting requirements.
- C. Special Techniques:
  - 1. Equipment Mounting:
    - a. Attach panelboard to vertical finished or structural surface behind panelboard.
    - b. Mount surface-mounted panelboards to steel slotted supports 1-1/4 inch in depth. Orient steel slotted supports vertically.
    - c. Comply with requirements for seismic control devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."

2. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
3. Mount panelboard cabinet plumb and rigid without distortion of box.
4. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
5. Install overcurrent protective devices and controllers not already factory installed.
  - a. Set field-adjustable, circuit-breaker trip ranges.
  - b. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver in accordance with manufacturer's published instructions.
6. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
7. Install filler plates in unused spaces.
8. Stub four 1 inch (25 mm) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in future. Stub four 1 inch (25 mm) empty conduits into raised floor space or below slab not on grade.
9. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
10. Mount spare fuse cabinet in accessible location.

D. Interfaces with Other Work:

1. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."
- B. Panelboard Nameplates: Label each panelboard with nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- C. Device Nameplates: Label each branch circuit device in power panelboards with nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.
- E. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles must be located on interior of panelboard door.

- F. Breaker Labels: Faceplate must list current rating, UL and IEC certification standards, and AIC rating.
- G. Circuit Directory:
  - 1. Provide computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.
    - a. Circuit directory must identify specific purpose with detail sufficient to distinguish it from other circuits.
  - 2. Create directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

### 3.4 FIELD QUALITY CONTROL

- A. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- B. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA ATS, Paragraph 7.6 Circuit Breakers. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  - 3. Perform the following infrared scan tests and inspections and prepare reports:
    - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
    - b. Follow-up Infrared Scanning: Perform additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
    - c. Instruments and Equipment:
      - 1) Use infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- C. Nonconforming Work:
  - 1. Panelboards will be considered defective if they do not pass tests and inspections.
  - 2. Remove and replace defective units and retest.
- D. Collect, assemble, and submit test and inspection reports, including certified report that identifies panelboards included and that describes scanning results, with comparisons of two

scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

E. Manufacturer Services:

1. Engage factory-authorized service representative to support field tests and inspections.

3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Coordination Studies."
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.
  1. Measure loads during period of normal facility operations.
  2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
  3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
  4. Tolerance: Maximum difference between phase loads, within panelboard, may not exceed 20 percent.

3.6 PROTECTION

- A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature in accordance with manufacturer's published instructions.

END OF SECTION 262416

## SECTION 262726 - WIRING DEVICES

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. General-use switches
2. Dimmer switches.
3. General-grade single straight-blade receptacles.
4. General-grade duplex straight-blade receptacles.
5. Receptacles with ground-fault protective devices.
6. Special-purpose power outlet assemblies.

##### B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
3. Section 260923 "Lighting Control Devices" for occupancy sensors, timers, control-voltage switches, and control-voltage dimmers.

#### 1.2 DEFINITIONS

- A. Commercial/Industrial-Use Cord Reel: A cord reel subject to severe use in factories, commercial garages, construction sites, and similar locations requiring a harder service-type cord.
- B. UL 1472 Type I Dimmer: Dimmer in which air-gap switch is used to energize preset lighting levels.

#### 1.3 ACTION SUBMITTALS

##### A. Product Data:

1. General-use switches
2. Dimmer switches.
3. General-grade single straight-blade receptacles.
4. General-grade duplex straight-blade receptacles.
5. Receptacles with ground-fault protective devices.
6. Special-purpose power outlet assemblies.

B. Shop Drawings:

1. Wiring diagrams for duplex straight-blade receptacles with integral switching means.

C. Field quality-control reports.

PART 2 - PRODUCTS

2.1 GENERAL-USE SWITCHES, DIMMER SWITCHES, AND FAN-SPEED CONTROLLER SWITCHES

A. Toggle Switch:

1. Regulatory Requirements:

- a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. General Characteristics:

- a. Reference Standards: UL CCN WМУZ and UL 20.

3. Options:

- a. Device Color: White
- b. Configuration:
  - 1) Extra-heavy-duty, 120-277 V, 20 A
  - 2) Refer to drawings for types used (single pole, double pole, three way, four way)

4. Accessories:

- a. Cover Plate: See section 260533.13 "Boxes and Covers for Electrical systems" for cover plate types and requirements.

B. Dimmer Switch:

1. Basis of Design: Wattstopper

2. Regulatory Requirements:

- a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

3. Options:

- a. Device Color: White.
- b. Switch Style: Push button.

- c. Dimming Control: 0-10V.
- 4. Accessories:
  - a. Cover Plate: See section 260533.13 "Boxes and Covers for Electrical systems" for cover plate types and requirements.

## 2.2 GENERAL-GRADE SINGLE STRAIGHT-BLADE RECEPTACLES

### A. Single Straight-Blade Receptacle:

- 1. Regulatory Requirements:
  - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
- 2. General Characteristics:
  - a. Reference Standards: UL CCN RTRT and UL 498.
- 3. Options:
  - a. Device Color: White.
  - b. Configuration:
    - 1) Extra-heavy-duty, NEMA 5-20R unless indicated otherwise on plans.
- 4. Accessories:
  - a. Cover Plate: See section 260533.13 "Boxes and Covers for Electrical systems" for cover plate types and requirements.

## 2.3 GENERAL-GRADE DUPLEX STRAIGHT-BLADE RECEPTACLES

### A. Duplex Straight-Blade Receptacle:

- 1. Regulatory Requirements:
  - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
- 2. General Characteristics:
  - a. Reference Standards: UL CCN RTRT and UL 498.
- 3. Options:
  - a. Device Color: White.



b. Configuration:

- 1) Extra-heavy-duty, smooth face, NEMA 5-20R.

4. Accessories:

- a. Cover Plate: See section 260533.13 "Boxes and Covers for Electrical systems" for cover plate types and requirements.

## 2.4 RECEPTACLES WITH GROUND-FAULT PROTECTIVE DEVICES

### A. General-Grade, Weather-Resistant, Duplex Straight-Blade Receptacle with GFCI Device:

1. Regulatory Requirements:

- a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. General Characteristics:

- a. Reference Standards: UL CCN KCXS, UL 498, and UL 943.

3. Options:

- a. Device Color: White.
- b. Configuration: Heavy-duty, NEMA 5-20R.

4. Accessories:

- a. Cover Plate: See section 260533.13 "Boxes and Covers for Electrical systems" for cover plate types and requirements.

## 2.5 SPECIAL-PURPOSE POWER OUTLET ASSEMBLIES

### A. Spring-Driven Commercial/Industrial-Use Cord Reel, No. 12 AWG Conductors

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. General Characteristics:

- a. Reference Standards: UL CCN SBCV and UL 355.
- b. Spring take-up retraction mechanism.

3. Options:

- a. Electrical Rating with Cable: 600 V, 20A min.
- b. Ball stop.
- c. Pivot base.

d. Spool Capacity:

- 1) No. 12 AWG, two wires and equipment ground, 50 ft.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receptacles:

1. Verify that receptacles to be procured and installed for Owner-furnished equipment are compatible with mating attachment plugs on equipment.

B. Cord Reels:

1. Examine roughing-in for cord reel mounting and power connections to verify actual locations of mounts and power connections before cord reel installation.
2. Examine walls, floors, and ceilings for suitable conditions where cord reel will be installed.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF SWITCHES

A. Comply with manufacturer's instructions.

B. Reference Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
3. Consult Architect for resolution of conflicting requirements.

C. Identification:

1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."

3.3 INSTALLATION OF STRAIGHT-BLADE RECEPTACLES

A. Comply with manufacturer's instructions.

B. Reference Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.

3. Receptacle Orientation: Unless otherwise indicated in Contract Documents, orient receptacle to match configuration diagram in NEMA WD 6.
4. Consult Architect for resolution of conflicting requirements.

C. Identification:

1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."

3.4 INSTALLATION OF CORD REELS AND FITTINGS

- A. Comply with manufacturer's instructions.

3.5 FIELD QUALITY CONTROL OF SWITCHES

A. Tests and Inspections:

1. Perform tests and inspections in accordance with manufacturers' instructions.

B. Nonconforming Work:

1. Unit will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

3.6 FIELD QUALITY CONTROL OF STRAIGHT-BLADE RECEPTACLES

A. Tests and Inspections:

1. Insert and remove test plug to verify that device is securely mounted.
2. Verify polarity of hot and neutral pins.
3. Measure line voltage.
4. Measure percent voltage drop.
5. Measure grounding circuit continuity; impedance must be not greater than 2 ohms.

B. Nonconforming Work:

1. Device will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

3.7 FIELD QUALITY CONTROL OF CORD REELS AND FITTINGS

A. Tests and Inspections:

1. Perform tests and inspections indicated in manufacturer's instructions.

B. Nonconforming Work:

1. Components and assemblies will be considered defective if they do not pass tests and inspections.
2. Remove and replace defective units and retest.

### 3.8 SYSTEM STARTUP FOR SWITCHES

- A. Engage a factory-authorized service representative to perform startup service.
  1. Complete installation and startup checks for momentary switches and dimmer switches in accordance with manufacturer's instructions.

### 3.9 ADJUSTING

- A. Cord Reels and Fittings: Adjust spring mechanisms and moving parts of cord reels and fittings to function smoothly, and lubricate as recommended in writing by manufacturer.

### 3.10 PROTECTION

- A. Devices:
  1. Schedule and sequence installation to minimize risk of contamination of wires and cables, devices, device boxes, outlet boxes, covers, and cover plates by plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other materials.
  2. After installation, protect wires and cables, devices, device boxes, outlet boxes, covers, and cover plates from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.
- B. Cord Reels and Fittings:
  1. After installation, protect cord reels and fittings from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.
- C. Connectors, Cords, and Plugs:
  1. After installation, protect connectors, cords, and plugs from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 262726

## SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Receptacle switches.
4. Shunt trip switches.
5. Molded-case circuit breakers (MCCBs).
6. Enclosures.

##### B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

#### 1.2 DEFINITIONS

- A. GFEP: Ground-fault circuit-interrupter for equipment protection.
- B. GFLS: Ground-fault circuit-interrupter for life safety.
- C. SPDT: Single pole, double throw.

#### 1.3 ACTION SUBMITTALS

##### A. Product Data:

1. For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
2. Enclosure types and details for types other than UL 50E, Type 1.
3. Current and voltage ratings.
4. Short-circuit current ratings (interrupting and withstand, as appropriate).
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

##### B. Shop Drawings: For enclosed switches and circuit breakers.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include wiring diagrams for power, signal, and control wiring.

C. Field Quality-Control Submittals:

1. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Warranty documentation.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain products from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.2 FUSIBLE SWITCHES

A. Type HD, Heavy Duty:

1. Single throw.
2. Three pole.
3. 240V(ac).
4. 1200 A and smaller.
5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses.
6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

B. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Service-Rated Switches: Labeled for use as service equipment.
5. Lugs: **Mechanical** type, suitable for number, size, and conductor material.

## 2.3 NONFUSIBLE SWITCHES

- A. Type HD, Heavy Duty, Three Pole, Single Throw, **240V(ac)**, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- B. Accessories:
  - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
  - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
  - 3. Lugs: Mechanical type, suitable for number, size, and conductor material.

## 2.4 SHUNT TRIP SWITCHES

- A. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with Class J fuse block and 200 kA interrupting and short-circuit current rating.
- B. Three Pole, Single-Throw Fusible Switch: 240V(ac), 100A; UL 98 and NEMA KS 1; integral shunt trip mechanism; horsepower rated, with clips or bolt pads to accommodate indicated fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- C. Control Circuit: 120 V(ac); obtained from integral control power transformer, with primary and secondary fuses, of enough capacity to operate shunt trip, pilot, indicating and control devices.
- D. Accessories:
  - 1. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
  - 2. Three-pole, double-throw, fire-safety and alarm relay; **120 VAC** coil voltage.
  - 3. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.
  - 4. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
  - 5. Form C alarm contacts that change state when switch is tripped.
  - 6. Lugs: **Mechanical** type, suitable for number, size, and conductor material.

## 2.5 MOLDED-CASE CIRCUIT BREAKERS

- A. Circuit breakers must be constructed using glass-reinforced insulating material. Current carrying components must be completely isolated from handle and accessory mounting area.
- B. Circuit breakers must have toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. Circuit-breaker handle must be over center, be trip free, and reside in tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon must be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with push-to-trip button, located on face of circuit breaker to mechanically operate circuit-breaker tripping mechanism for maintenance and testing purposes.

- C. Maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings must be clearly marked on face of circuit breaker. Circuit breakers shall be fully rated for the available short circuit current.
- D. MCCBs must be equipped with device for locking in isolated position.
- E. Standard: Comply with UL 489 with required interrupting capacity for available fault currents.
- F. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- G. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- H. Electronic Trip Circuit Breakers: Field-replaceable rating plug, RMS sensing, with the following field-adjustable settings:
  - 1. Instantaneous trip.
  - 2. Long- and short-time pickup levels.
  - 3. Long- and short-time time adjustments.
  - 4. Ground-fault pickup level, time delay, and I-squared t response.
- I. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
- J. GFLS Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6 mA trip).
- K. GFEP Circuit Breakers: With Class B ground-fault protection (30 mA trip).
- L. Features and Accessories:
  - 1. Standard frame sizes, trip ratings, and number of poles.
  - 2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
  - 3. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
  - 4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
  - 5. Communication Capability: **Integral** communication module with functions and features compatible with power monitoring and control system, specified in Section 260913 "Electrical Power Monitoring and Control."

## 2.6 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, UL 50E, and UL 50, to comply with environmental conditions at installed location.



- B. Conduit Entry: UL 50E Types 4, 4X, and 12 enclosures may not contain knockouts. UL 50E Types 7 and 9 enclosures must be provided with threaded conduit openings in both endwalls.
- C. Operating Mechanism: Circuit-breaker operating handle must be externally operable with operating mechanism being integral part of box, not cover. Cover interlock mechanism must have externally operated override. Override may not permanently disable interlock mechanism, which must return to locked position once override is released. Tool used to override cover interlock mechanism must not be required to enter enclosure in order to override interlock.
- D. Enclosures designated as UL 50E Type 4, 4X stainless steel, 12, or 12K must have dual cover interlock mechanism to prevent unintentional opening of enclosure cover when circuit breaker is ON and to prevent turning circuit breaker ON when enclosure cover is open.
- E. UL 50E Type 7/9 enclosures must be furnished with breather and drain kit to allow their use in outdoor and wet location applications.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
  - 1. Commencement of work will indicate Installer's acceptance of areas and conditions as satisfactory.

#### 3.2 SELECTION OF ENCLOSURES

- A. Indoor, Dry and Clean Locations: UL 50E, Type 1.
- B. Outdoor Locations: UL 50E, Type 3R.
- C. Wash-Down Areas: UL 50E, Type 4X.
- D. Other Wet or Damp, Indoor Locations: UL 50E, Type 4.
- E. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: UL 50E, Type 12.

#### 3.3 INSTALLATION

- A. Comply with manufacturer's published instructions.
- B. Special Techniques:

1. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
2. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
3. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
4. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
5. Install fuses in fusible devices.

### 3.4 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  2. Label each enclosure with engraved metal or laminated-plastic nameplate.

### 3.5 FIELD QUALITY CONTROL

- A. Tests and Inspections for Switches:
1. Visual and Mechanical Inspection:
    - a. Inspect physical and mechanical condition.
    - b. Inspect anchorage, alignment, grounding, and clearances.
    - c. Verify that unit is clean.
    - d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
    - e. Verify that fuse sizes and types match the Specifications and Drawings.
    - f. Verify that each fuse has adequate mechanical support and contact integrity.
    - g. Inspect bolted electrical connections for high resistance using one of the following methods:
      - 1) Use low-resistance ohmmeter.
        - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of lowest value.
      - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
        - a) Bolt-torque levels must be in accordance with manufacturer's published data. In absence of manufacturer's published data, use NETA ATS Table 100.12.

- h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on Drawings.
- i. Verify correct phase barrier installation.
- j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.

2. Electrical Tests:

- a. Perform resistance measurements through bolted connections with low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.
- b. Measure contact resistance across each switchblade fuseholder. Drop values may not exceed high level of manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.
- c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In absence of manufacturer's published data, use Table 100.1 from NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
- d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
- e. Perform ground fault test in accordance with NETA ATS Section 7.14 "Ground Fault Protection Systems, Low-Voltage."

B. Tests and Inspections for Molded-Case Circuit Breakers:

1. Visual and Mechanical Inspection:

- a. Verify that equipment nameplate data are as described in the Specifications and shown on Drawings.
- b. Inspect physical and mechanical condition.
- c. Inspect anchorage, alignment, grounding, and clearances.
- d. Verify that unit is clean.
- e. Operate circuit breaker to ensure smooth operation.
- f. Inspect bolted electrical connections for high resistance using one of the following methods:
  - 1) Use low-resistance ohmmeter.
    - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of lowest value.
  - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.

- a) Bolt-torque levels must be in accordance with manufacturer's published data. In absence of manufacturer's published data, use NETA ATS Table 100.12.
  - g. Inspect operating mechanism, contacts, and chutes in unsealed units.
  - h. Perform adjustments for final protective device settings in accordance with coordination study.
- 2. Electrical Tests:
  - a. Perform resistance measurements through bolted connections with low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.
  - b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In absence of manufacturer's published data, use Table 100.1 from NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
  - c. Perform contact/pole resistance test. Drop values may not exceed high level of manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.
  - d. Perform insulation resistance tests on control wiring with respect to ground. Applied potential must be 500 V(dc) for 300 V rated cable and 1000 V(dc) for 600 V rated cable. Test duration must be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values may be no less than 2 M  $\Omega$ .
  - e. Determine the following by primary current injection:
    - 1) Long-time pickup and delay. Pickup values must be as specified. Trip characteristics may not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
    - 2) Short-time pickup and delay. Short-time pickup values must be as specified. Trip characteristics may not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
    - 3) Ground-fault pickup and time delay. Ground-fault pickup values must be as specified. Trip characteristics may not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
    - 4) Instantaneous pickup. Instantaneous pickup values must be as specified and within manufacturer's published tolerances.
  - f. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of shunt trip and close coils must be as indicated by manufacturer.
  - g. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset trip logs and indicators. Investigate units that do not function as designed.
  - h. Verify operation of charging mechanism. Investigate units that do not function as designed.

3. Test and adjust controls, remote monitoring, and safeties.

C. Nonconforming Work:

1. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
2. Remove and replace defective units and retest.

D. Collect, assemble, and submit test and inspection reports.

1. Test procedures used.
2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
3. List deficiencies detected, remedial action taken, and observations after remedial action.

### 3.6 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Coordination Studies".

### 3.7 PROTECTION

- A. After installation, protect enclosed switches and circuit breakers from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

### 3.8 MAINTENANCE

- A. Infrared Scanning of Enclosed Switches and Breakers: Two months after Substantial Completion, perform infrared scan of joints and connections. Remove covers so joints and connections are accessible to portable scanner. Take visible light photographs at same locations and orientations as infrared scans for documentation to ensure follow-on scans match same conditions for valid comparison.
  1. Instruments and Equipment: Use infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
  2. Follow-up Infrared Scanning: Perform two follow-up infrared scans of enclosed switches and breakers, one at four months and another at 11 months after Substantial Completion.
  3. Instrument: Use infrared-scanning device designed to measure temperature or to detect significant deviations from normal values. Provide documentation of device calibration.
  4. Report: Prepare certified report that identifies units checked and that describes scanning results. Include notation of deficiencies detected, remedial actions taken, and scanning observations after remedial action.

DPW ADMINISTRATIVE BUILDING  
City of Rye, NY

September 12, 2024

END OF SECTION 262816

SECTION 263213 – PACKAGED DIESEL-ENGINE-DRIVEN GENERATOR SYSTEMS

PART 1 - GENERAL

1.01 CODES AND STANDARDS

- A. The generator set installation and on-site testing shall conform to the requirements of the following codes and standards:
  - 1. CSA 282, 1989 Emergency Electrical Power Supply for Buildings.
  - 2. IEEE446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.
  - 3. NFPA37 –
  - 4. NFPA70 – National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.
  - 5. NFPA110 – Emergency and Standby Power Systems. The generator set shall meet all requirements for Level 1 systems. Level 1 prototype tests required by this standard shall have been performed on a complete and functional unit, component level type tests will not substitute for this requirement.
- B. The generator set and supplied accessories shall meet the requirements of the following standards:
  - 1. NEMA MG1-1998 part 32. Alternator shall comply with the requirements of this standard.
  - 2. UL142 – Sub-base Tanks.
  - 3. UL1236 – Battery Chargers.
  - 4. UL2200. The generator set shall be listed to UL2200 or submit to an independent third party certification process to verify compliance as installed.
- C. The control system for the generator set shall comply with the following requirements.
  - 1. CSA C22.2, No. 14 – M91 Industrial Control Equipment.
  - 2. EN50082-2, Electromagnetic Compatibility – Generic Immunity Requirements, Part 2: Industrial.
  - 3. EN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.
  - 4. FCC Part 15, Subpart B.
  - 5. IEC8528 part 4. Control Systems for Generator Sets.
  - 6. IEC Std 801.2, 801.3, and 801.5 for susceptibility, conducted, and radiated electromagnetic emissions.
  - 7. UL508. The entire control system of the generator set shall be UL508 listed and labeled.
  - 8. UL1236 –Battery Chargers.

- D. The generator set manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.

#### 1.02 SUBMITTALS

- A. Shop Drawings: Indicate electrical characteristics and connection requirements. Show plan and elevation views with overall and interconnection point dimensions, fuel consumption rate curves at various loads, ventilation and combustion air requirements, and electrical diagrams including schematic and interconnection diagrams.
- B. Product Data: Provide data showing dimensions, weights, ratings, interconnection points, and internal wiring diagrams for engine, generator, microprocessor control panel, battery, battery rack, battery charger, exhaust silencer, vibration isolators, fuel tank, trailer and radiator.
- C. Prototype Test Reports: Submittals will not be received without submission of prototype test report as specified herein.
- 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. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.
- F. Alternator data indicating sub transient reactance and temperature rise rating to meet requirements specified herein.

#### 1.03 OPERATION AND MAINTENANCE

- A. Manuals: Furnish four (4) Operation and Maintenance manuals.
- B. Operation & Maintenance Data: Include instructions for routine maintenance requirements, service manuals for engine and day tank, oil sampling and analysis for engine wear, and emergency maintenance procedures.

#### 1.04 QUALITY ASSURANCE

- A. To provide proven reliability of the Generator set, three series of tests shall be performed, no exceptions taken:
  - 1. Prototype model tests
  - 2. Fully assembled factory production model tests
  - 3. Field acceptance tests



- B. The manufacturer shall provide documentation demonstrating satisfactory prototype and production test results. Generator sets that have not been prototype tested and Factory Production tested as described herein shall not be acceptable.
- C. Generator set Prototype Tests: These tests and evaluations must have been performed on a prototype generator set representative of the model specified. A summary of the generator set testing results shall be submittal for review. The manufacturer's standard series of components development tests on the generator system, engine and other major components shall be performed and available for review, but shall not be acceptable as a substitute for a prototype testing on the complete representative generator set prototype.
- D. Torsiograph Analysis and Test: The manufacturer of the generator set shall verify that the engine generator set, as configured, is free from harmful torsional stresses. The analysis shall include correlation of empirical data from tests on a representative prototype. The empirical data must include spectrum analysis of the torsional transducer output within the operating speed range of the engine generator set. Calculations based on engine and generator separately are not acceptable.
- E. Temperature Rise Test: Complete thermal evaluation of a prototype generator rotor and starter must include actual measurement of internal generator and exciter temperatures by embedded detector method, and measurement of average temperature rise by resistance method. No position measured any place in the windings may exceed the temperature rise limits of NEMA for the particular type of insulation system used. Resistance method temperature rise data shall be confirmed by a full load test on the generator set prototype to include conducted and radiated heat from the engine.
- F. Short Circuit Test: A test on a prototype generator set shall have demonstrated that the generator set is designed to withstand the mechanical forces associated with a short circuit condition. With the generator set operating at rated load and speed, the generator terminals must be short circuited on all three phases for a duration of 20 seconds. At the conclusion of this test, the generator set must be capable of full load operation.
- G. Endurance Run Test: A minimum of 500 continuous hours of endurance testing with a representative generator set prototype operating as defined by the manufacturer's standby rating shall have been performed. Endurance testing shall be used to verify structural soundness and durability.
- H. Maximum Power Test: With the prototype generator set at normal operating temperature and with all power consuming auxiliaries in place, the maximum power available at rated speed shall be determined with the governor set at its fuel stop. The generator set shall maintain this power for a minimum of two (2) minutes.
- I. Linear Vibration Test: A test for in-line motion of components occurring along a repeatable path shall meet the manufacturer's acceptable criteria.
- J. Cooling System Test: A cooling system test shall demonstrate the ability of the generator set cooling system to maintain normal operating temperature while operating at full rated load and power factor at the highest ambient temperature (122 °F) of the system rating.

Cooling air requirements, radiator air flow and maximum allowable restriction at radiator discharge shall be verified by this test.

- K. Maximum Motor Starting KVA Test: Motor starting KVA shall be determined by test, based on a sustained RMS recovery voltage of at least 90 percent on no load voltage with the specified load KVA at near zero power factor applied to the generator set.
- L. Transient Response, Steady State Speed Control and Voltage Regulation Test: Prototype generator set tests shall demonstrate consistent performance as follows; stable voltage and frequency at all loads from no load to full rated load, consistent frequency kp on load acceptance and rejection and restoration to steady state after sudden load changes. Transient response is a complete generator set (engine, generator, exciter, and regulator) performance criteria and cannot be established on generator data alone.
- M. Witness-Generator Set Factory Production Tests: On the equipment to be shipped, a four-(4) hour test shall be performed at rated load and 0.8 PF. These tests shall include certified data to document the following: run at full load, maximum power, voltage regulation, transient and steady state governing, single step load pickup and safety shutdowns. Provide a factory test record of the production testing. The Contractor and/or equipment supplier at their expense shall coordinate and provide all transportation and lodging for the owner and Owner's engineering representative to witness the above stated factory test. Tests performed at facilities other than the manufacturer's factory shall not be acceptable.
- N. Factory Test: The unit shall completely assembled and all preliminary adjustments made before the test is initiated.
- O. Testing Procedure:
  - 1. Test diesel-alternator unit at 0.8 PF in the following sequence:
  - 2. 0.5 hour at  $\frac{1}{4}$  load.
  - 3. 1.0 hours at  $\frac{1}{2}$  load.
  - 4. 1.0 hours at  $\frac{3}{4}$  load.
  - 5. 1.5 hours at full load.
- P. Above testing shall be strip chart recorded and certified. During this test, the following measurements shall be taken and recorded on a certified report format:
  - 1. RPM.
  - 2. Output voltage per phase.
  - 3. Output amperes per phase.
  - 4. Power Factor.
  - 5. KW.
  - 6. Transient response testing from 0 to 100%
- Q. Above testing shall be strip chart recorded. Provide necessary equipment and instruments to measure voltage dips and frequency dips. Comparison shall be made to the herein specified alternator performance characteristics prior to acceptance.

- R. Field Acceptance Tests: Generator supplier shall provide and conduct a two (2) hour load bank test at unity power factor for the generator set. Contractor must provide portable load bank for testing generator set at 100% load. Load bank test shall test each generator at full nameplate KW ratings. Generator manufacturer's representative shall record test data, as described below. Test data shall be tabulated and typed for submission and approval by the engineer for final acceptance. No handwritten field notes will be allowed.
- S. Initial start up and field acceptance tests are to be conducted by the authorized representative of the system manufacturer who supplies the equipment. Contractor responsible for protection of testing equipment and any additional cable, etc., required if equipment cannot be located internally during testing.
- T. Test data shall be collected and recorded on the following: Time of day, coolant temperature, operating oil pressure, battery charging rate, cranking time, crank-to-rated frequency time, voltage and frequency overshoot, load assumption-to-steady state voltage and frequency stabilization time, operating voltage, frequency, current, kilowatts and power factor. All data shall be taken every fifteen (15) minutes.

#### 1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten (10) years documented experience, and with an authorized distributor offering 24 hour parts and service availability within 50 miles of the project. Proposed engine/generator combination shall have been in production a minimum of five (5) years.
- B. Supplier: Authorized distributor of specified manufacturer with minimum five (5) years documented experience with specified products and factory-trained service technicians.

#### 1.06 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70, NFPA 110, and NFPA 101.
- B. Furnish Products listed and classified by Underwriters Laboratories as suitable for purpose specified and indicated.

#### 1.07 PRE-INSTALLATION CONFERENCE

- A. Convene one (1) week prior to commencing work of this Section.

#### 1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site.
- B. Accept unit on site mounted on trailer. Inspect for damage. Provide written verification that Genset tested and Genset received are one and the same.

- C. Protect equipment from dirt and moisture by securely wrapping in heavy plastic during construction

#### 1.09 WARRANTY

- A. A no deductible comprehensive warranty shall be provided for all products against defects in materials and workmanship for a five-year or 1500 hour period from the start-up date. Warranty shall cover all costs of covered repairs, including travel expenses.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Basis of Design product:
  - 1. Cummins Power Generation, model 450 KW DFEJ rated for STANDBY POWER with B259 Frame Alternator as distributed by Cummins Inc, 890 Zerega Avenue, Bronx, NY 10473. Contact Colm Kelly – 347 266 6023
- B. The loads of this project are based on the Cummins engine parameters only and any other manufacturer used will be subject to review and any additional costs will be borne by the contractor. It is intended that all products specified herein be of standard ratings, therefore, the KW and KVA, starting KVA and maximum allowable voltage dip, ratings, etc., shall be the manufacturer's next size or rating to exactly meet the specifications. No exceptions.
- C. Alternates, subject to compliance with the project specifications and site conditions:
  - 1. Caterpillar
  - 2. Kohler

#### 2.02 DIESEL ENGINE-GENERATOR SET

- A. Ratings
  - 1. The generator set shall operate at 1800 rpm and at a voltage of: 208 Volts AC, 3- phase, 4-wire, 60 hertz.
  - 2. The generator set shall be rated at 450 kW, 563 kVA at 0.8 PF, standby rating, based on site conditions of : Altitude 1000 ft., ambient temperatures up to 122 degrees F (50 degrees C).
- B. Performance
  - 1. Voltage regulation shall be plus or minus 0.5 percent for any constant load between no load and rated load. Random voltage variation with any steady load from no load to full load shall not exceed plus or minus 0.5 percent.
  - 2. Frequency regulation shall be isochronous from steady state no load to steady state rated load. Random frequency variation with any steady load from no load to full load shall not exceed plus or minus 0.25%.

3. The diesel engine-generator set shall accept a single step load of 100% nameplate kW and power factor, less applicable derating factors, with the engine-generator set at operating temperature.
  4. Motor starting capability shall be a minimum of 920 kVA. The generator set shall be capable of recovering to a minimum of 90% of rated no load voltage following the application of the specified kVA load at near zero power factor applied to the generator set.
  5. The alternator shall produce a clean AC voltage waveform, with not more than 5% total harmonic distortion at full linear load, when measured from line to neutral, and with not more than 3% in any single harmonic, and no 3<sup>rd</sup> order harmonics or their multiples. Telephone influence factor shall be less than 40.
  6. The generator set shall be certified by the engine manufacturer to be suitable for use at the installed location and rating, and shall meet all applicable exhaust emission requirements at the time of commissioning.
- C. Construction
1. The engine-generator set shall be mounted on a heavy-duty steel base to maintain alignment between components. The base shall incorporate a battery tray with hold-down clamps within the rails.
  2. All switches, lamps, and meters in the control system shall be oil-tight and dust-tight. All active control components shall be installed within a UL/NEMA 3R enclosure. There shall be no exposed points in the control (with the door open) that operate in excess of 50 volts.
- D. Connections
1. The generator set load connections shall be composed of silver or tin plated copper bus bars, drilled to accept mechanical or compression terminations of the number and type as shown on the drawings. Sufficient lug space shall be provided for use with cables of the number and size as shown on the drawings.
  2. Power connections to auxiliary devices shall be made at the devices to a 100 amp mounted panel inside enclosure.
  3. Generator set control interfaces to other system components shall be made on a permanently labeled terminal block assembly. Labels describing connection point functions shall be provided.

## 2.03 ENGINE AND ENGINE EQUIPMENT

- A. The engine shall be diesel EPA TIER 2 Certified, 4 cycle, radiator and fan cooled. Gross engine brake horsepower to be 755 minimum, with 6 cylinders. The horsepower rating of the engine at its minimum tolerance level shall be sufficient to drive the alternator and all connected accessories. Two cycle engines are not acceptable.
- B. A digital electronic governor system shall provide automatic isochronous frequency regulation. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine

operating temperature conditions. The control system shall actively control the fuel rate and excitation as appropriate to the state of the generator set. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, accelerating to rated speed. The governing system shall include a programmable warm up at idle and cooldown at idle function. While operating in idle state, the control system shall disable the alternator excitation system.

- C. Skid-mounted radiator and cooling system rated for full load operation in 122 degrees F (50 degrees C) ambient as measured at the alternator air inlet. Radiator fan shall be suitable for use in a system with 0.5 in H<sub>2</sub>O restriction. Radiator shall be sized based on a core temperature that is 20F higher than the rated operation temperature, or prototype tested to verify cooling performance of the engine/radiator/fan operation in a controlled environment. Radiator shall be provided with a duct adapter flange. The equipment manufacturer shall fill the cooling system with a 50/50-ethylene glycol/water mixture prior to shipping. Rotating parts shall be guarded against accidental Electric starter(s) capable of three complete cranking cycles without overheating.

## 2.04 ENGINE ACCESSORY EQUIPMENT

- A. The engine for the generator shall include the following accessories:
  - 1. Positive displacement, contact.
  - 2. Mechanical, full pressure, lubrication oil pump.
  - 3. Full flow lubrication oil filters with replaceable spin-on canister elements and dipstick oil level indicator.
  - 4. An engine driven, mechanical, positive displacement fuel pump. Fuel filter with replaceable spin-on canister element. Fuel cooler, suitable for operation of the generator set at full rated load in the ambient temperature specified shall be provided if required for operation due to the design of the engine and the installation.
  - 5. Replaceable dry element air cleaner with restriction indicator.
  - 6. Flexible supply and return fuel lines.
  - 7. Engine mounted battery charging alternator, 40-ampere minimum, and solid-state voltage regulator.
- B. Coolant heater
  - 1. Engine mounted, thermostatically controlled, coolant heater(s) for each engine. Heater voltage shall be as shown on the project drawings. The coolant heater shall be UL499 listed and labeled.
  - 2. The coolant heater shall be installed on the engine with silicone hose connections. Steel tubing shall be used for connections into the engine coolant system wherever the length of pipe run exceeds 12 inches. The coolant heater installation shall be specifically designed to provide proper venting of the system. The coolant heaters shall provisions to isolate the heater for replacement of the heater element without draining the coolant from the generator set. The quick disconnect/automatic sealing couplers shall allow the heater element to be replaced without draining the engine cooling system or significant coolant loss.

3. The coolant heater shall be provided with a 24VDC thermostat, installed at the engine thermostat housing. An AC power connection box shall be provided for a single AC power connection to the coolant heater system.
  4. The coolant heater(s) shall be 120V, 1500 watts and sized as recommended by the engine manufacturer to warm the engine to a minimum of 104F (40C) in a 40F (4C) ambient, in compliance with NFPA110 requirements, or the temperature required for starting and load pickup requirements of this specification.
- C. Provide vibration isolators, spring/pad type, quantity as recommended by the generator set manufacturer.
- D. Starting and Control Batteries shall be calcium/lead antimony type, 12 volt DC, sized as recommended by the engine manufacturer, complete with battery cables and connectors. The batteries shall be capable of a minimum of three complete 15-second cranking cycles at 40F ambient temperature when fully charged.
- E. Provide exhaust silencer for each engine of size and type as recommended by the generator set manufacturer and approved by the engine manufacturer. The mufflers shall be critical grade. Exhaust system shall be installed inside the sound enclosure.
- F. A UL listed/CSA certified 6 amp voltage regulated battery charger shall be provided for each engine-generator set. Input AC voltage and DC output voltage shall be as required. Chargers shall be equipped with float, taper and equalize charge settings. Operational monitors shall provide visual output along with individual form C contacts rated at 4 amps, 120 VAC, 30VDC for remote indication of:
- Loss of AC power - red light
  - Low battery voltage - red light
  - High battery voltage - red light
  - Power ON - green light (no relay contact)
- G. Charger shall include an Analog DC voltmeter and ammeter, 12 hour equalize charge timer, and AC and DC fuses.

## 2.05 AC ALTERNATOR

- A. The AC generator shall be; synchronous, four pole, 2/3 pitch, revolving field, drip-proof construction, single prelubricated sealed bearing, air cooled by a direct drive centrifugal blower fan, and directly connected to the engine with flexible drive disc. All insulation system components shall meet NEMA MG1 temperature limits for Class H insulation system and shall be UL1446 listed. Actual temperature rise measured by resistance method at full load shall not exceed 105 degrees Centigrade.
- B. The generator shall be capable of delivering rated output (kVA) at rated frequency and power factor, at any voltage not more than 5 percent above or below rated voltage.
- C. A permanent magnet generator (PMG) shall be included to provide a reliable source of excitation power for optimum motor starting and short circuit performance. The PMG

and controls shall be capable of sustaining and regulating current supplied to a single phase or three phase fault at approximately 300% of rated current for not more than 10 seconds.

- D. The subtransient reactance of the alternator shall not exceed 5 percent, based on the 105 °C rise rating.
- E. Alternator shall be rated for a minimum of 450 KW at a 105 degrees C, standby.

## 2.06 ENGINE GENERATOR SET CONTROL

- A. Generator set Control. The generator set shall be provided with a microprocessor-based control system that is designed to provide automatic starting, monitoring, and control functions for the generator set. The control system shall also be designed to allow local monitoring and control of the generator set, and remote monitoring and control as described in this specification.
- B. The control shall be mounted on the generator set, or may be mounted in a free-standing panel next to the generator set if adequate space and accessibility is available. The control shall be vibration isolated and prototype tested to verify the durability of all components in the system under the vibration conditions encountered.
- C. Control Switches
  - 1. Mode Select Switch. The mode select switch shall initiate the following control modes. When in the RUN or MANUAL position the generator set shall start, and accelerate to rated speed and voltage as directed by the operator. A separate push-button to initiate starting is acceptable. In the OFF position the generator set shall immediately stop, bypassing all time delays. In the AUTO position the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.
  - 2. EMERGENCY STOP switch. Switch shall be Red "mushroom-head" push-button. Depressing the emergency stop switch shall cause the generator set to immediately shut down, and be locked out from automatic restarting.
  - 3. RESET switch. The RESET switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.
  - 4. PANEL LAMP switch. Depressing the panel lamp switch shall cause the entire panel to be lighted with DC control power. The panel lamps shall automatically be switched off 10 minutes after the switch is depressed, or after the switch is depressed a second time.
- D. Generator Set AC Output Metering. The generator set shall be provided with a metering set including the following features and functions:
  - 1. Digital metering set, .5% accuracy, to indicate generator RMS voltage and current, frequency, output current, output KW, KW-hours, and power factor. Generator output voltage shall be available in line-to-line and line-to-neutral voltages, and shall display all three-phase voltages (line to neutral or line to line) simultaneously.



2. Analog voltmeter, ammeter, frequency meter, power factor meter, and kilowatt (KW) meter. Voltmeter and ammeter shall display all three phases. Meter scales shall be color coded in the following fashion: green shall indicate normal operating condition, amber shall indicate operation in ranges that indicate potential failure, and red shall indicate failure impending. Metering accuracy shall be within 1% at rated output. Both analog and digital metering are required.
3. The control system shall monitor the total load on the generator set, and maintain data logs of total operating hours at specific load levels ranging from 0 to 110% of rated load, in 10% increments. The control shall display hours of operation at less than 30% load and total hours of operation at more than 90% of rated load.
4. The control system shall log total number of operating hours, total kWh, and total control on hours, as well as total values since reset.

E. Generator Set Alarm and Status Display.

1. The generator set control shall include LED alarm and status indication lamps. The lamps shall be high-intensity LED type. The lamp condition shall be clearly apparent under bright room lighting conditions. Functions indicated by the lamps shall include:
  - a. The control shall include five configurable alarm-indicating lamps. The lamps shall be field adjustable for any status, warning, or shutdown function monitored by the genset. They shall also be configurable for color, and control action (status, warning, or shutdown).
  - b. The control shall include green lamps to indicate that the generator set is running at rated frequency and voltage, and that a remote start signal has been received at the generator set. The running signal shall be based on actual sensed voltage and frequency on the output terminals of the generator set.
  - c. The control shall include a flashing red lamp to indicate that the control is not in automatic state, and red common shutdown lamp.
  - d. The control shall include an amber common warning indication lamp.
2. The generator set control shall indicate the existence of the warning and shutdown conditions on the control panel. All conditions indicated below for warning shall be field-configurable for shutdown. Conditions required to be annunciated shall include:
  - low oil pressure (warning)
  - low oil pressure (shutdown)
  - oil pressure sender failure (warning)
  - low coolant temperature (warning)
  - high coolant temperature (warning)
  - high coolant temperature (shutdown)
  - high oil temperature (warning)
  - engine temperature sender failure (warning)
  - low coolant level (warning)
  - fail to crank (shutdown)
  - fail to start/overcrank (shutdown)
  - overspeed (shutdown)
  - low DC voltage (warning)

- high DC voltage (warning)
- weak battery (warning)
- low fuel-daytank (warning)
- high AC voltage (shutdown)
- low AC voltage (shutdown)
- under frequency (shutdown)
- over current (warning)
- over current (shutdown)
- short circuit (shutdown)
- ground fault (warning) (optional--when required by code or specified)
- over load (warning)
- emergency stop (shutdown)
- (4) configurable conditions

3. Provisions shall be made for indication of four customer-specified alarm or shutdown conditions. Labeling of the customer-specified alarm or shutdown conditions shall be of the same type and quality as the above-specified conditions. The non-automatic indicating lamp shall be red, and shall flash to indicate that the generator set is not able to automatically respond to a command to start from a remote location.

F. Engine Status Monitoring.

1. The following information shall be available from a digital status panel on the generator set control
  - engine oil pressure (psi or kPA)
  - engine coolant temperature (degrees F or C)
  - engine oil temperature (degrees F or C)
  - engine speed (rpm)
  - number of hours of operation (hours)
  - number of start attempts
  - battery voltage (DC volts)
2. The control system shall also incorporate a data logging and display provision to allow logging of the last 10 warning or shutdown indications on the generator set, as well as total time of operation at various loads, as a percent of the standby rating of the generator set.
3. Provide and install a 20-light LED type remote alarm annunciator with horn, located as shown on the drawings or in a location that can be conveniently monitored by facility personnel. The remote annunciator shall provide all the audible and visual alarms called for by NFPA Standard 110 for level 1 systems for the local generator control panel. Spare lamps shall be provided to allow future addition of other alarm and status functions to the annunciator. Provisions for labeling of the annunciator in a fashion consistent with the specified functions shall be provided. Alarm silence and lamp test switch(es) shall be provided. LED lamps shall be replaceable, and indicating lamp color shall be capable of changes needed for specific application requirements. Alarm horn shall be switchable for all annunciation points. Alarm horn (when switched on) shall sound for first fault, and all subsequent faults, regardless of whether first fault

has been cleared, in compliance with NFPA110 3-5.6.2. The interconnecting wiring between the annunciator and other system components shall be monitored and failure of the interconnection between components shall be displayed on the annunciator panel.

The annunciator shall include the following alarm labels, audible annunciation features, and lamp colors:

<u>Condition</u>	<u>Lamp Color</u>	<u>Audible Alarm</u>
Normal Power (to Loads)	Green	No
Genset Supplying Load	Amber	No
Genset Running	Green	No
Not in Auto	Red (Flashing)	Yes
High Battery Voltage	Red	Yes
Low Battery Voltage	Red	Yes
Charger AC Failure	Red	Yes
Fail to Start	Red	Yes
Low Engine Temperature	Amber	Yes
Pre-High Engine Temperature	Amber	Yes
High Engine Temperature	Red	Yes
Pre-Low Oil Pressure	Amber	Yes
Low Oil Pressure	Red	Yes
Overspeed	Red	Yes
Low Coolant Level	Amber	Yes
Low Fuel Level	Amber	Yes
Network OK	Green	Yes
(4) Spares	Configurable	Configurable

## 2.07 ENGINE CONTROL FUNCTIONS

- A. The control system provided shall include a cycle cranking system, which allows for user selected crank time, rest time, and # of cycles. Initial settings shall be for 3 cranking periods of 15 seconds each, with 15-second rest period between cranking periods.
- B. The control system shall include an idle mode control, which allows the engine to run in idle mode in the RUN position only. In this mode, the alternator excitation system shall be disabled. Total duration of operating time in the idle mode shall be controlled by the system, to prevent degradation of the engine capabilities due to excess operating time at idle.
- C. The control system shall include an engine governor control, which functions to provide steady state frequency regulation as noted elsewhere in this specification. The governor control shall include adjustments for gain, damping, and a ramping function to control engine speed and limit exhaust smoke while the unit is starting.

- D. The control system shall include time delay start (adjustable 0-300 seconds) and time delay stop (adjustable 0-600 seconds) functions.
- E. The control system shall include sender failure monitoring logic for speed sensing, oil pressure, and engine temperature which is capable of discriminating between failed sender or wiring components, and an actual failure conditions.

## 2.08 ALTERNATOR CONTROL FUNCTIONS

- A. The generator set shall include a full wave rectified automatic digital voltage regulation system that is matched and prototype tested by the engine manufacturer with the governing system provided. It shall be immune from misoperation due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter. The voltage regulation system shall be equipped with three-phase line to neutral RMS sensing and shall control buildup of AC generator voltage to provide a linear rise and limit overshoot. The system shall include a torque-matching characteristic, which shall reduce output voltage in proportion to frequency below an adjustable frequency threshold. Torque matching characteristic shall be adjustable for roll-off frequency and rate, and be capable of being curve-matched to the engine torque curve with adjustments in the field. The voltage regulator shall include adjustments for gain, damping, and frequency roll-off. Adjustments shall be broad range, and made via digital raise-lower switches, with an alphanumeric LED readout to indicate setting level. Rotary potentiometers for system adjustments are not acceptable.
- B. Controls shall be provided to monitor the output current of the generator set and initiate an alarm (over current warning) when load current exceeds 110% of the rated current of the generator set on any phase for more than 60 seconds. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (over current shutdown). The protective functions provided shall be in compliance to the requirements of NFPA70 article 445.
- C. Controls shall be provided to individually monitor all three phases of the output current for short circuit conditions. The control/protection system shall monitor the current level and voltage. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (short circuit shutdown). The protective functions provided shall be in compliance to the requirements of NFPA70 article 445.
- D. Controls shall be provided to monitor the KW load on the generator set, and initiate an alarm condition (over load) when total load on the generator set exceeds the generator set rating for in excess of 5 seconds. Controls shall include a load shed control, to operate a set of dry contacts (for use in shedding customer load devices) when the generator set is overloaded.
- E. An AC over/under voltage monitoring system that responds only to true RMS voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110% of the operator-set voltage level for more

than 10 seconds, or with no intentional delay when voltage exceeds 130%. Under voltage shutdown shall occur when the output voltage of the alternator is less than 85% for more than 10 seconds.

- F. When required by National Electrical Code or indicated on project drawings, the control System shall include a ground fault monitoring relay. The relay shall be adjustable from 3.8-1200 amps, and include adjustable time delay of 0-10.0 seconds. The relay shall be for indication only, and not trip or shut down the generator set. Note bonding and grounding requirements for the generator set, and provide relay that will function correctly in system as installed.

## 2.09 OTHER CONTROL FUNCTIONS

- A. A battery monitoring system shall be provided which initiates alarms when the DC control and starting voltage is less than 25VDC or more than 32 VDC. During engine cranking (starter engaged), the low voltage limit shall be disabled, and DC voltage shall be monitored as load is applied to the battery, to detect impending battery failure or deteriorated battery condition.

## 2.10 GENERATOR MAIN LINE CIRCUIT BREAKER

- A. The generator set shall be provided with a mounted main line circuit breaker, rated 1600 amps. The circuit breaker shall incorporate an electronic trip unit that operates to protect the alternator under all overcurrent conditions, or a thermal-magnetic trip with other overcurrent protection devices that positively protect the alternator under overcurrent conditions. The supplier shall submit time overcurrent characteristic curves and thermal damage curve for the alternator, demonstrating the effectiveness of the protection provided.

## 2.11 OUTDOOR WEATHER-PROTECTIVE SOUND ATTENUATED ENCLOSURE

- A. Construction:
  - 1. Steel - UL2200 listed Sound Attenuated, Weatherproof Genset Enclosure
    - a. Package shall comply with the requirements of the NEC for all wiring materials and components.
    - b. Sound attenuation rating of 74 dBA @ 7m.
    - c. The enclosure shall be designed in which allows generator set to operate at full rated load in an ambient temperature of up to 100 F.
- B. The enclosure will consist of a cambered roof, two sidewalls, two end walls, and a nominal 300 gallon fuel tank base, incorporating prepainted steel construction and application-specific non-hydroscopic acoustic insulation, air handling equipment designed to provide the specified level of sound attenuation.
- C. Exhaust silencer shall be installed inside enclosure. The exhaust shall exit the enclosure through a rain collar and terminate with rain cap.
- D. Enclosure Power and Wiring, all battery charger, block heaters, shall be pre-wired within

the enclosure so that only a single point, 208 volt, 3-phase, 4-wire connection is required to power the enclosure. Provide a 100 amp load center with main circuit breaker for all loads within the enclosure.

- A. The enclosure shall include flexible coolant and lubricating oil drain lines, that extend to the exterior of the enclosure with internal drain valves.
- B. External radiator fill provision must be provided.
- C. Doors shall be recessed, lockable with retainers to hold doors open for easy access.
- D. Inlet of enclosure shall be provided with rodent barriers.

## 2.12 SUBBASE FUEL TANK

- A. Provide a sub-base nominal 300 gallon fuel tank for the generator set. The sub-base fuel tank shall be UL142 listed and labeled. Installation shall be in compliance to NFPA37. The fuel tank shall be a double-walled, steel construction and include the following features:
  - 1. Emergency tank and basin vents.
  - 2. Mechanical level gauge.
  - 3. Fuel supply and return lines, connected to generator set with flexible fuel lines as recommended by the engine manufacturer and in compliance to UL2200 and NFPA 37 requirements.
  - 4. Leak detection provisions, wired to the generator set control for local and remote alarm indication.
  - 5. Low level float switches to indicate fuel level. Wire switches to generator control for local and remote indication of fuel level.
  - 6. Basin drain.
  - 7. Integral lifting provisions.

## PART 3 - EXECUTION

### 3.01 ACCEPTANCE

- A. Equipment shall be initially started and operated by representatives of the manufacturer.
- B. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to final testing of the system.

### 3.02 TRAINING

- A. The equipment supplier shall provide training for the facility operating personnel covering operation and maintenance of the equipment provided. The training program shall be not less than two (2) four (4) hours sessions in duration and the class size shall be limited to five (5) persons. Training date shall be coordinated with the facility owner.

### 3.03 DEMONSTRATION

- A. Provide systems demonstration. Electric Contractor shall provide fuel for testing and shall fill tank complete after all testing is done and before turning over to Owner.
- B. Describe loads connected to standby system and restrictions for future load additions.
- C. Simulate power outage by interrupting normal source, and demonstrate that system operates to provide standby power.

### 3.04 INSTALLATION (BY CONTRACTOR)

- A. Comply with NECA 1 and NECA 404.
- B. Comply with packaged engine generator manufacturers' written installation and alignment instructions and with NFPA 110.
- C. Equipment Mounting:
  - 1. Install packaged engine generators on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified on drawings and in Section 033000 "Cast-in-Place Concrete."
  - 2. Coordinate size and location of concrete bases for packaged engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- D. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.
- E. Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

### 3.05 CONNECTIONS

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Provide a minimum of one 90-degree bend in flexible conduit routed to the engine generator from a stationary element.
- C. Balance single-phase loads to obtain a maximum of 10 percent unbalance between any two phases.

### 3.06 IDENTIFICATION

- A. Identify system components according to Section 260553 "Identification for Electrical Systems."

### 3.07 FIELD QUALITY CONTROL

- A. Testing Agency:

- 1. Perform tests and inspections with the assistance of a factory-authorized service representative.

- B. Tests and Inspections:

- 1. Perform tests recommended by manufacturer and each visual and mechanical inspection and electrical and mechanical test listed in first two subparagraphs below, as specified in NETA ATS. Certify compliance with test parameters.

- a) Visual and Mechanical Inspection:

- (1) Compare equipment nameplate data with Drawings and the Specifications.
      - (2) Inspect physical and mechanical condition.
      - (3) Inspect anchorage, alignment, and grounding.
      - (4) Verify that the unit is clean.

- b) Electrical and Mechanical Tests:

- (1) Perform insulation-resistance tests according to IEEE 43.

Machines Larger Than 200 hp (150 kW): Test duration shall be 10 minutes.  
Calculate polarization index.

- (2) Test protective relay devices.
      - (3) Verify phase rotation, phasing, and synchronized operation as required by the application.
      - (4) Functionally test engine shutdown for low oil pressure, overtemperature, overspeed, and other protection features as applicable.
      - (5) Verify correct functioning of the governor and regulator.
- 2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here, including, but not limited to, single-step full-load pickup test.
- 3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
  - a) Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.



- b) Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
  - c) Verify acceptance of charge for each element of the battery after discharge.
  - d) Verify that measurements are within manufacturer's specifications.
- 4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
- 5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine generator system before and during system operation. Check for air, exhaust, and fluid leaks.
- 6. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
- 7. Harmonic-Content Tests: Measure harmonic content of output voltage at 25 and 100 percent of rated linear load. Verify that harmonic content is within specified limits.
- 8. Noise Level Tests: Measure A-weighted level of noise emanating from engine generator installation, including engine exhaust and cooling-air intake and discharge, at **four** locations 25 feet (8 m) from edge of the generator enclosure, and at the nearest property line. Submit results to engineer.
- C. Coordinate tests with tests for transfer switches and run them concurrently.
- D. Test instruments shall have been calibrated within the past 12 months, traceable to NIST Calibration Services, and adequate for making positive observation of test results. Make calibration records available for examination on request.
- E. Leak Test: After installation, charge exhaust, coolant, and fuel systems and test for leaks. Repair leaks and retest until no leaks exist.
- F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation for generator and associated equipment.
- G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- H. Remove and replace malfunctioning units and retest as specified above.
- I. Retest: Correct deficiencies identified by tests and observations, and retest until specified requirements are met.
- J. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- K. Infrared Scanning: After Substantial Completion, but not more than 60 days after final acceptance, perform an infrared scan of each power wiring termination and each bus

connection while running with maximum load. Remove all access panels so terminations and connections are accessible to portable scanner.

1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan 11 months after date of Substantial Completion.
2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
3. Record of Infrared Scanning: Prepare a certified report that identifies terminations and connections checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

- END OF SECTION -

## SECTION 263600 - TRANSFER SWITCHES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Contactor-type automatic transfer switches.
2. Transfer switch accessories.

#### 1.2 ACTION SUBMITTALS

A. Product Data:

1. Contactor-type automatic transfer switches.
2. Transfer switch accessories.

B. Product Data Submittals: For each product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for transfer switches.
2. Include rated capacities, operating characteristics, electrical characteristics, and accessories.

C. Shop Drawings:

1. Include plans, elevations, sections, details showing minimum clearances, conductor entry provisions, gutter space, and installed features and devices.
2. Include material lists for each switch specified.
3. Single-Line Diagram: Show connections between transfer switch, bypass/isolation switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.
4. Riser Diagram: Show interconnection wiring between transfer switches, bypass/isolation switches, annunciators, and control panels.

#### 1.3 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Data: Certificates, for transfer switches, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

- B. Field quality-control reports.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Features and operating sequences, both automatic and manual.
    - b. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

#### 1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications:
  - 1. Member company of NETA.
    - a. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

#### 1.6 FIELD CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:
  - 1. Notify Construction Manager no fewer than five days in advance of proposed interruption of electrical service.
  - 2. Do not proceed with interruption of electrical service without Owner's written permission.

#### 1.7 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of transfer switch or transfer switch components that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 18 months from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NEMA ICS 1.
- C. Comply with NFPA 110.
- D. Comply with UL 1008 unless requirements of these Specifications are stricter.
- E. Tested Fault-Current Closing and Short-Circuit Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
- F. Repetitive Accuracy of Solid-State Controls: All settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.
- G. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.62. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- H. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism. Switches for emergency or standby purposes shall be mechanically and electrically interlocked in both directions to prevent simultaneous connection to both power sources unless closed transition.
- I. Neutral Switching: Where four-pole switches are indicated, provide neutral pole switched simultaneously with phase poles.
- J. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.
- K. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, by color-code or by numbered or lettered wire and cable markers at terminations.
  - 1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
  - 2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
  - 3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
  - 4. Accessible via Front and Rear access.
- L. Enclosures: General-purpose NEMA 250, Type 3R or 4X, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

## 2.2 CONTACTOR-TYPE AUTOMATIC TRANSFER SWITCHES

- A. Basis of Design: ASCO 7000 series, Automatic, Open Transition with Isolation Bypass.
- B. Comply with Level 1 equipment according to NFPA 110.
- C. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
  - 1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are unacceptable.
  - 2. Switch Action: Double throw; mechanically held in both directions.
  - 3. Contacts: Silver composition or silver alloy for load-current switching. Contactor-style automatic transfer-switch units, rated 600 A and higher, shall have separate arcing contacts.
  - 4. Conductor Connectors: Suitable for use with conductor material and sizes.
  - 5. Material: Hard-drawn copper, 98 percent conductivity.
  - 6. Main and Neutral Lugs: Mechanical type.
  - 7. Ground Lugs and Bus-Configured Terminators: Mechanical type.
  - 8. Ground bar.
  - 9. Connectors shall be marked for conductor size and type according to UL 1008.
- D. Automatic Open-Transition Transfer Switches: Interlocked to prevent the load from being closed on both sources at the same time.
  - 1. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.
- E. Manual Switch Operation, Load-Breaking: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.
- F. Manual Switch Operation, Non-Load-Breaking: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.
- G. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.
- H. Automatic Transfer-Switch Controller Features:
  - 1. Controller operates through a period of loss of control power.
  - 2. Undervoltage Sensing for Each Phase of Normal and Generator Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage shall be adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
  - 3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.

4. Time Delay for Retransfer to Normal Source: Adjustable from zero to 30 minutes, and factory set for 10 minutes. Override shall automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
5. Test Switch: Simulate normal-source failure.
6. Switch-Position Pilot Lights: Indicate source to which load is connected.
7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
  - a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
  - b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
9. Transfer Override Switch: Overrides automatic retransfer control so transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
11. Engine Shutdown Contacts:
  - a. Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
12. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods shall be adjustable from 10 to 30 minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
  - a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
  - b. Push-button programming control with digital display of settings.
  - c. Integral battery operation of time switch when normal control power is unavailable.

## 2.3 TRANSFER SWITCH ACCESSORIES

### A. Bypass/Isolation Switches:

1. Source Limitations: Same manufacturer as transfer switch in which installed.
2. Comply with requirements for Level 1 equipment according to NFPA 110.
3. Description: Manual type, arranged to select and connect either source of power directly to load, isolating transfer switch from load and from both power sources. Include the following features for each combined automatic transfer switch and bypass/isolation switch:

- a. Means to lock bypass/isolation switch in the position that isolates transfer switch with an arrangement that permits complete electrical testing of transfer switch while isolated. Interlocks shall prevent transfer-switch operation, except for testing or maintenance, while automatic transfer switch is isolated.
  - b. Provide means to make power available to transfer-switch control circuit for testing and maintenance purposes.
  - c. Drawout Arrangement for Transfer Switch: Provide physical separation from live parts and accessibility for testing and maintenance operations. Transfer switch and bypass/isolation switch shall be in isolated compartments.
  - d. Transition:
    - 1) Provide open-transition operation when transferring between power sources.
  - e. Bypass/Isolation Switch Current, Voltage, Closing, and Short-Circuit Withstand Ratings: Equal to or greater than those of associated automatic transfer switch, and with same phase arrangement and number of poles.
  - f. Contact temperatures of bypass/isolation switches shall not exceed those of automatic transfer-switch contacts when they are carrying rated load.
  - g. Manual Control: Constructed so load bypass and transfer-switch isolation can be performed by one person in no more than two operations in 15 seconds or less. Operating handles shall be externally operated.
  - h. Automatic and Nonautomatic Control: Automatic transfer-switch controller shall also control the bypass/isolation switch.
  - i. Legend: Manufacturer's standard legend for control labels and instruction signs shall describe operating instructions.
  - j. Maintainability: Fabricate to allow convenient removal of major components from front without removing other parts or main power conductors.
4. Interconnection of Bypass/Isolation Switches with Automatic Transfer Switches: Factory-installed copper bus bars; plated at connection points and braced for the indicated available short-circuit current.

B. Remote Annunciator System:

1. Source Limitations: Same manufacturer as transfer switch in which installed.
2. Functional Description: Remote annunciator panel shall annunciate conditions for indicated transfer switches.
3. Annunciation panel display shall include the following indicators:
  - a. Sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
  - b. Switch position.
  - c. Switch in test mode.
  - d. Failure of communication link.
4. Annunciator Panel: LED-lamp type with audible signal and silencing switch.
  - a. Indicating Lights: Grouped for each transfer switch monitored.
  - b. Label each group, indicating transfer switch it monitors, location of switch, and identity of load it serves.
  - c. Mounting: Flush, modular, steel cabinet unless otherwise indicated.
  - d. Lamp Test: Push-to-test or lamp-test switch on front panel.



5. Malfunction of annunciator, annunciation and control panel, or communication link shall not affect functions of automatic transfer switch. In the event of failure of communication link, automatic transfer switch automatically shall revert to standalone, self-contained operation. Automatic transfer-switch sensing, controlling, or operating function shall not depend on remote panel for proper operation.
6. Remote Annunciation and Control Panel: Solid-state components. Include the following features:
  - a. Controls and indicating lights grouped together for each transfer switch.
  - b. Label each indicating light control group. Indicate transfer switch it controls, location of switch, and load it serves.
  - c. Digital Communication Capability: Matched to that of transfer switches supervised.
  - d. Mounting: Flush, modular, steel cabinet unless otherwise indicated.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Floor-Mounting Switch: Anchor to floor by bolting.
  1. Install transfer switches on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
  2. Comply with requirements for seismic control devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."
  3. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.
  4. Provide workspace and clearances required by NFPA 70.
- B. Identify components according to Section 260553 "Identification for Electrical Systems."
- C. Set field-adjustable intervals and delays, relays, and engine exerciser clock.
- D. Comply with NECA 1.

#### 3.2 CONNECTIONS

- A. Wiring to Remote Components: Match type and number of cables and conductors to generator sets, control, and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.
- B. Wiring Method: Install cables in raceways and cable trays except within electrical enclosures. Conceal raceway and cables except in unfinished spaces.
  1. Comply with requirements for raceways specified in Section 260533.13 "Conduits for Electrical Systems."

- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
- D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- F. Route and brace conductors according to manufacturer's written instructions. Do not obscure manufacturer's markings and labels.
- G. Brace and support equipment according to Section 260548.16 "Seismic Controls for Electrical Systems."

### 3.3 FIELD QUALITY CONTROL

#### A. Adminstrant for Tests and Inspections:

- 1. Administer and perform tests and inspections with assistance of factory-authorized service representative.

#### B. Tests and Inspections:

- 1. After installing equipment, test for compliance with requirements according to NETA ATS.
- 2. Visual and Mechanical Inspection:
  - a. Compare equipment nameplate data with Drawings and Specifications.
  - b. Inspect physical and mechanical condition.
  - c. Inspect anchorage, alignment, grounding, and required clearances.
  - d. Verify that the unit is clean.
  - e. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
  - f. Verify that manual transfer warnings are attached and visible.
  - g. Verify tightness of all control connections.
  - h. Inspect bolted electrical connections for high resistance using one of the following methods, or both:
    - 1) Use of low-resistance ohmmeter.
    - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data.
  - i. Perform manual transfer operation.
  - j. Verify positive mechanical interlocking between normal and alternate sources.
  - k. Perform visual and mechanical inspection of surge arresters.
  - l. Inspect control power transformers.
    - 1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.

- 2) Verify that primary and secondary fuse or circuit-breaker ratings match Drawings.
  - 3) Verify correct functioning of drawout disconnecting contacts, grounding contacts, and interlocks.
3. Electrical Tests:
  - a. Perform insulation-resistance tests on all control wiring with respect to ground.
  - b. Perform a contact/pole-resistance test. Compare measured values with manufacturer's acceptable values.
  - c. Verify settings and operation of control devices.
  - d. Calibrate and set all relays and timers.
  - e. Verify phase rotation, phasing, and synchronized operation.
  - f. Perform automatic transfer tests.
  - g. Verify correct operation and timing of the following functions:
    - 1) Normal source voltage-sensing and frequency-sensing relays.
    - 2) Engine start sequence.
    - 3) Time delay on transfer.
    - 4) Alternative source voltage-sensing and frequency-sensing relays.
    - 5) Automatic transfer operation.
    - 6) Interlocks and limit switch function.
    - 7) Time delay and retransfer on normal power restoration.
    - 8) Engine cool-down and shutdown feature.
4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
  - a. Check for electrical continuity of circuits and for short circuits.
  - b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
  - c. Verify that manual transfer warnings are properly placed.
  - d. Perform manual transfer operation.
5. After energizing circuits, perform each electrical test for transfer switches stated in NETA ATS and demonstrate interlocking sequence and operational function for each switch at least three times.
  - a. Simulate power failures of normal source to automatic transfer switches and retransfer from emergency source with normal source available.
  - b. Simulate loss of phase-to-ground voltage for each phase of normal source.
  - c. Verify time-delay settings.
  - d. Verify pickup and dropout voltages by data readout or inspection of control settings.
  - e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
  - f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for one pole deviating by more than 50 percent from other poles.

- g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
- 6. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
  - a. Verify grounding connections and locations and ratings of sensors.
- C. Coordinate tests with tests of generator and run them concurrently.
- D. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- E. Transfer switches will be considered defective if they do not pass tests and inspections.
- F. Remove and replace malfunctioning units and retest as specified above.
- G. Prepare test and inspection reports.
- H. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
  - 1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
  - 2. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
  - 3. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.

#### 3.4 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment.
- B. Training shall include testing ground-fault protective devices and instructions to determine when the ground-fault system shall be retested. Include instructions on where ground-fault sensors are located and how to avoid negating the ground-fault protection scheme during testing and circuit modifications.
- C. Coordinate this training with that for generator equipment.

END OF SECTION 263600

## SECTION 265119 - LED INTERIOR LIGHTING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Interior solid-state luminaires that use LED technology.
  - 2. Lighting fixture supports.
- B. Related Requirements:
  - 1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

#### 1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Arrange in order of luminaire designation.
  - 2. Include data on features, accessories, and finishes.
  - 3. Include physical description and dimensions of luminaires.
  - 4. Include emergency lighting units, including batteries and chargers.

5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
  6. Photometric data and adjustment factors based on laboratory tests
    - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
    - b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
- B. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Photometric Study: Reflected ceiling plan, drawn to scale, on which the following items are shown:
1. Lighting luminaires.
  2. Luminaire tags corresponding to fixture schedule
  3. Calculation summary table with average footcandle levels and uniformity data shown for each room.
  4. Foot-candle point calculations on plan in a 2' x 2' grid, taken at workplane height.
  5. Provide a separate calculation for emergency lighting mode. Coordinate emergency light fixture locations with contract drawings. Fixtures to provide lumen output based on battery pack wattage to be provided.
- B. Product Certificates: For each type of luminaire.
- C. Product Test Reports: For each luminaire, for tests performed by a qualified testing agency.
- D. Sample warranty.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

#### 1.7 QUALITY ASSURANCE

- A. Provide luminaires from a single manufacturer for each luminaire type.
- B. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.9 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  - 1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.2 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Recessed Fixtures: Comply with NEMA LE 4.
- C. CRI and CCT as per luminaire schedule.
- D. Rated lamp life of 50,000 hours minimum.
- E. Lamps dimmable from 100 percent to 10 percent of maximum light output.
- F. Internal driver.
- G. Nominal Operating Voltage: 120 V ac.

2.3 MATERIALS

- A. Metal Parts:
  - 1. Free of burrs and sharp corners and edges.
  - 2. Sheet metal components shall be steel unless otherwise indicated.
  - 3. Form and support to prevent warping and sagging.

- B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- C. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
  - 1. Label shall include the following lamp characteristics:
    - a. "USE ONLY" and include specific lamp type.
    - b. Lamp diameter, shape, size, wattage, and coating.
    - c. CCT and CRI for all luminaires.

## 2.4 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

## 2.5 LUMINAIRE FIXTURE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.
- D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.



### 3.2 TEMPORARY LIGHTING

- A. Electrical contractor to provide temporary lighting during construction. Use of the permanent luminaires for temporary lighting will not be acceptable.

### 3.3 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
  - 1. Sized and rated for luminaire weight.
  - 2. Able to maintain luminaire position after cleaning and relamping.
  - 3. Provide support for luminaire without causing deflection of ceiling or wall.
  - 4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.
- E. Flush-Mounted Luminaire Support:
  - 1. Secured to outlet box.
  - 2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
  - 3. Trim ring flush with finished surface.
- F. Wall-Mounted Luminaire Support:
  - 1. Attached to structural members in walls.
  - 2. Do not attach luminaires directly to gypsum board.
- G. Ceiling-Mounted Luminaire Support:
  - 1. Ceiling mount with two 5/32-inch diameter aircraft cable supports.
  - 2. Ceiling mount with pendant mount with 5/32-inch diameter aircraft cable supports.
- H. Suspended Luminaire Support:
  - 1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
  - 2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
  - 3. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- I. Ceiling-Grid-Mounted Luminaires:
  - 1. Secure to any required outlet box.

2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
  3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.
- J. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

#### 3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

#### 3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
  2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

#### 3.6 STARTUP SERVICE

- A. Comply with requirements for startup specified in Section 260923 "Lighting Control Devices."

END OF SECTION 265119

## **SECTION 31 00 00**

### **EARTHWORK**

#### **PART 1 - GENERAL**

##### **1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions and Special Conditions, apply to this Section.
- B. "Standard Specifications" shall mean the State of New York Department of Transportation Standard Specifications, its latest edition, and any supplemental specifications.

##### **1.02 SECTION INCLUDES**

- A. All excavation and placement of fill not included under other sections. Place, compact and dispose of excess excavated materials in accordance with the plans, specifications and directions of the Engineer.
- B. Saw cutting existing pavements and existing curbs.
- C. Rock excavation and removal as specified herein, and as needed for the completion of the work.
  - 1. When rock is encountered in the work of this Section the excavation and removal of that rock shall comply with "Standard Specifications" and as specified herein.
  - 2. No additional payment will be made for rock excavation and removal needed during the completion of the work of this Section.

##### **1.03 RELATED SECTIONS**

- A. Section 02 41 13 – Site Demolition and Removals
- B. Section 31 25 00 – Erosion and Sedimentation Controls

##### **1.04 DEFINITIONS**

- A. "Suitable Material" or "Acceptable Material"
  - 1. ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM; free of rock or gravel larger than three (3) inches in any dimension, debris, waste, frozen material, vegetation and other deleterious material.
  - 2. Any mineral (inorganic) soil, blasted or broken rock and similar materials of natural or man made origin, including mixtures thereof, are considered acceptable materials.

- B. "Unacceptable Material" - ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH and PT.

#### 1.05 QUALITY ASSURANCE

- A. Material Standards: As defined in Standard Specifications inclusive of all supplements.
- B. Testing: Compaction tests will be required by the Engineer and will be paid for by the Contractor. If tests indicate that density requirements have not been achieved, continue compacting. All re-testing in unsatisfactory areas shall be paid for by the Contractor.
- C. Density and Compaction Testing: The Contractor is responsible to schedule compaction tests as required by the Engineer and to allow adequate time for the proper execution of said tests. A minimum of 48-hour notice shall be required.

#### 1.06 PROTECTION

- A. Dust Control: Use all means necessary to control dust on and near the construction areas caused by the Contractor's performance of the work in conformance with Standard Specifications.

### **PART 2 - PRODUCTS**

#### 2.01 MATERIALS

- A. Backfill, Fill and Embankment Materials: Any acceptable material as determined by the Engineer, EXCEPT within six (6) inches of finished grade.
- B. Subbase and Base Material: Conform to Standard Specifications, Section 304-2.02.
- C. Bedding Material: Conform to Standard Specifications, Section 603-3.03.

#### 2.02 WARNING TAPE

- A. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, minimum 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:
  - 1. Red: Electric.
  - 2. Yellow: Gas, oil, steam, and dangerous materials.
  - 3. Orange: Telephone and other communications.
  - 4. Blue: Water systems.
  - 5. Green: Sewer systems.

### **PART 3 - EXECUTION**

### 3.01 GENERAL

- A. The entire area of work shall be brought to the required lines and grades by excavation and filling. Excavated materials, acceptable in the opinion of the Engineer, shall be used in making embankments and filling the low areas of the work, and at such places as the Engineer may direct.
- B. Excavate to the limits shown on the Drawings to subgrade level. Compact subgrade level before placing fill, base or subbase materials.
- C. Construct base course to required depths and elevations below all concrete pads, foundations and bituminous concrete.
- D. Construct bedding course below all drainage and utility structures.
- E. Place suitable/ acceptable material below all lawn and landscaped areas. No rocks larger than 2 inches in any dimension shall be placed within 4 inches of the finished grade. Material that does not meet this requirement and cannot be used within the project site either be screened to meet these requirements or properly removed from the site.

### 3.02 COMPACTION REQUIREMENTS

- A. Compact soil to not less than the following percentages of maximum dry density according to ASTM 1557:
  - 1. Under foundations, concrete pads, and pavements, compact the top 12 inches below subgrade and each layer of backfill or fill material at 95 percent maximum dry density.

### 3.03 EXCAVATION

- A. Protect Structures, utilities, sidewalks, pavements and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations. Any damage to existing structures or utilities that occurs as a result of the Contractor's operations shall be corrected by the Contractor at no additional cost to the Project.
- B. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.
- C. Provide erosion and control measures to prevent erosion or displacement of soils and discharge of soil-bearing water run-off or airborne dust to adjacent properties and watercourses, in accordance with the Sediment and Erosion Control Plan, details and as directed by the Engineer.
- D. Subgrade: All soft, boggy, clayey or other objectionable material below the proposed subgrade elevation shall be removed, and the area refilled with acceptable material. Upon discovery of such material, the Contractor shall notify the Engineer for evaluation.

- E. Boulders: The Contractor shall remove all boulders, stone or pieces of concrete, lumber, iron or other material that project above subgrade and dispose of off-site. Any stone larger than two (2) cubic feet in volume shall not be placed within two (2) feet of the finished surface.
- F. Excavating for Foundations: All excavations shall be cut accurately to required lines and dimensions for work on drawings and shall be large enough to provide adequate clearance for the proper execution of the work.
- G. Bottoms of Excavations: Level the bottoms of all excavations, to receive footings or other work supported on soil, accurately, to the lines and levels shown on the plans or as directed by the Engineer.
- H. Where excavation for a foundation has been carried below the indicated level by error, fill the space between the incorrect and required depth with concrete at no additional cost to NYS OPRHP.
- I. Storage and Placement: All those excavated materials which in the opinion of the Engineer are suitable for backfill shall be stored or placed within the limits of the Contract, where directed by the Engineer.
- J. Surplus: All surplus materials and materials not suitable for backfill shall be removed off-site. No additional payment will be made for this, but the cost thereof shall be deemed included in the price bid.
- K. Shoring: Wherever necessary to maintain the banks of excavation in a safe and stable condition, the Contractor shall furnish and install temporary sheet piling or planks, braces and shores of good sound timber of adequate strength, and shall remove such piling or shoring as the foundation work progresses.

Sheeting and bracing of a type approved by the Engineer, shall be installed when the Contractor's employees are required to enter into excavations which exceed four (4) feet in depth.

The foregoing shall include the construction and removal of sheeting and bracing, the excavation and maintenance of temporary ditches, and the furnishing and operation of pumps or other appliances needed to properly drain the work. No direct compensation will be made for this work, but payment therefore shall be deemed included in the price bid.

- L. Inspection: When the excavations have been carried to the required depth as shown on the drawings, the Contractor shall do no more work until after inspection by the Engineer, who shall order the foundation or other work to proceed, or further excavation, as the conditions indicate and no foundation or other work shall be done until the excavations have been approved by the Engineer.
- M. Bailing and Draining: The Contractor shall furnish all materials, appliances and labor required to keep the site of the work free from water, ice and snow during construction.
- N. Utilities and Services: When any sewer, water, gas, electric or other utility service connections are encountered in the excavation operations, the service shall not be

interrupted or disturbed by the Contractor unless called for on the plans and/or directed by the Engineer. It is the Contractor's responsibility to detect and protect existing utilities (to remain) from damage during construction. The Contractor shall locate buried utilities, to the best of his ability, using electronic probes, or other methods, prior to the start of excavation. The Contractor shall then proceed cautiously and perform hand excavation, as necessary, to protect the utility as directed by the Engineer, at no extra cost to NYS OPRHP. If a utility is inadvertently damaged, it is the Contractor's responsibility to restore that utility to operating condition, equal to that existing prior to damage. The Contractor shall remain at the site with the damaged utility until it has been restored and there is no danger to the public (i.e. exposed live electrical wires, etc.).

Should the Contractor need to cut off utilities or services during the performances of the work, he shall notify the City Department or Utility Company owning or controlling services, to cut off these services. It is the Contractor's responsibility to provide sufficient advance notice to the Utility Company so that work not be delayed. The cost of any such delay in work shall be solely borne by the Contractor.

Any services cut off or interrupted by the Contractor's operations shall be restored at the Contractor's expense.

- O. Over-excavate to depths as shown on plans and as directed by Engineer.

### 3.04 FILL

- A. Remove all vegetation, topsoil, debris, wet and unsatisfactory soil materials, obstructions, and deleterious materials from the ground surface prior to placing fills. Unsuitable subgrade material as determined by the Engineer may be removed in accordance with Section 3.3 D of this Specification.
- B. Fill and Compacting shall be carried out as directed by the Engineer, and shall be constructed in successive horizontal layers not over 6 inches in depth. It shall be spread by a "Bulldozer", or other acceptable methods, and shall be thoroughly compacted by rolling with a self-propelling roller weighing not less than ten (10) tons and completed to the satisfaction of the Engineer. In places where the character of the material makes the use of this roller impracticable or where drains or other construction may be damaged, a lighter one may be substituted, or the area shall be compacted by vibratory tamping, all with the approval, and to the satisfaction of the Engineer.
- C. All hollows and depressions which develop during the process of rolling and compacting shall be filled with acceptable material, and the subgrade shall again be compacted. This process of filling and compacting shall be repeated until no depressions develop.
- D. Plow, strip or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing surface.

- E. When subgrade or existing ground surface to receive fill has a density less than that required for fill, break up ground surface to depth required, pulverize, moisture-condition or aerate soil and recompact to required density.

### 3.05 BACKFILL

- A. After inspection and approval of foundations and other work, which is to be covered by backfill, the excavated voids shall be filled with clean excavated material, puddled and rammed solid every 6" of depth.
- B. After areas and trenches have been excavated and structures constructed therein, the spaces around and above them shall be carefully backfilled with acceptable material. Backfill shall be placed on both sides of structures to approximately the same elevation at the same time. All backfill shall be thoroughly tamped and rammed in place in layers not over six (6) inches in depth, using rammers of a weight acceptable to the Engineer. If directed by the Engineer, the backfill shall be thoroughly saturated with water as it is placed.
- C. Backfilling around manholes, catch basins and dry wells shall not take place until the mortar has hardened and the possibility of movement is slight. Backfilling shall take place uniformly around all sides of the structure.
- D. When sheeting is being withdrawn, all cavities left thereby shall be filled with acceptable material, tamped in place so as to fill all voids thoroughly. Backfill inside of sheeting shall be placed before sheeting is removed.
- E. All backfill shall be with suitable material, as defined in this specification or as determined by engineer.

### 3.06 SAW CUTTING

- A. All saw cutting shall be carried out to the full depth of the pavement, curb or concrete walk to be cut. Saw cutting shall be done to accurate, neat, and straight lines marked previous to commencement of work. Saw cutting shall be done with approved power saws specifically designed and manufactured for such a purpose. Compressor, backhoe or spade-cutting of the pavement will not be allowed.

### 3.07 ROCK EXCAVATION

- A. Rock excavation shall include the excavation, removal and disposal of solid rock, concrete and all boulders one cubic yard or more in volume which require drilling and splitting or other mechanical means. Blasting will NOT be allowed. Boulders of less than one cubic yard in volume or other materials found in excavations, however stiff, heavy and compact, including rippable rock, which, in the opinion of the Engineer, can be removed without drilling and wedging, shall not be considered as rock excavation.
- B. All loose, unsound, or semi-detached rock fragments, as determined by the Engineer, which may be detrimental to the proposed structure or installation shall be removed from the excavation. Excavation beyond the necessary limits, made to remove damaged rock shall be backfilled by the Contractor with compacted gravel fill at no additional cost to NYS OPRHP.



- C. Where boulders are on the sides of or in the bottom of excavations, they shall be wholly or partially removed at a minimum to the limits as specified and/or as determined by the Engineer. In removing boulders lodged in the sides of the excavations, the Contractor shall not disturb or undermine adjacent pavement or structures. Pavement surfaces damaged beyond reasonable limits as determined by the Engineer shall be repaired by the Contractor at no additional cost to NYS OPRHP. In general, boulders or rock fragments which extend under paved surfaces shall be removed by mechanical splitting.
- D. Unauthorized excavations in rock, or excavations made beyond or below the indicated limits shall be refilled and compacted with approved gravel fill at no additional cost to NYS OPRHP.
- E. Depressions below the required grade resulting from the removal of boulders and rock fragments shall be refilled with compacted gravel fill at no additional cost to NYS OPRHP.
- F. No additional payment will be made for rock excavation and removal needed during the completion of the work of this Section.

**END OF SECTION 31 00 00**

## **SECTION 31 23 16.13**

### **TRENCHING**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions and Special Conditions, apply to this Section.
- B. "Standard Specifications" shall mean the State of New York Department of Transportation Standard Specifications, May 1, 2024, its latest edition and any supplemental specifications.

##### **1.2 SECTION INCLUDES**

- A. Trenching, sheeting and dewatering as specified herein, and as needed for installation of sanitary sewer, storm drainage, water distribution, gas distribution, electrical supply and service, and appurtenances associated with the work.
- B. Rock in trench excavation and removal as specified herein, and as needed for installation of sanitary sewer, storm drainage, water distribution, gas distribution, electrical supply and service, and appurtenances associated with the work.
  - 1. When rock is encountered in work of trench excavation the removal of that rock shall comply with "Standard Specifications"
  - 2. No additional payment will be made for rock removal during trench excavation.

##### **1.3 RELATED WORK**

- A. Section 31 00 00 - Earthwork
- B. Section 33 30 00 - Sanitary Sewer

##### **1.4 QUALITY ASSURANCE**

- A. Use equipment adequate in size, capacity, and numbers to accomplish the work of this Section in a timely manner.
- B. Comply with requirements and regulations of utility companies and governmental agencies having jurisdiction.
- C. Refer to Section 31 00 00 - Earthwork for compaction requirements.

##### **1.5 PROJECT CONDITIONS**

- A. Contact Dig Safely New York (1.800.962.7962 or 811) to locate underground utilities prior to commencing site preparation operations.

## **PART 2 - PRODUCTS**

### **2.1 EQUIPMENT**

- A. As selected by the Contractor.

## **PART 3 - EXECUTION**

### **3.1 PROJECT CONDITIONS**

- A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed with the work of this section until unsatisfactory conditions are corrected.
- B. Finish Elevations and Lines:
  - 1. Locate and protect control points during progress of the Work.
  - 2. Preserve permanent reference points during progress of the Work.
  - 3. Do not change or relocate reference points or items of the Work without written approval from the Engineer.

### **3.2 EXECUTION**

- A. Utilities:
  - 1. Unless shown to be removed, protect active utility lines shown on the Drawings or otherwise made known to the Contractor prior to excavating. If damaged, repair or replace at no additional cost to the Owner.
  - 2. If active utility lines are encountered, and are not shown on the Drawings or otherwise made known to the Contractor, promptly take necessary steps to assure that service is not interrupted. Inform Engineer of existing utility line before proceeding.
  - 3. If service is interrupted as a result of work under this Section, immediately restore service by repairing the damaged utility at no additional cost to the Owner.
  - 4. If existing utilities are found to interfere with the permanent facilities being constructed under this Section, immediately notify the Engineer for review and written direction before proceeding with modifications to the work. Do not proceed with permanent relocation of utilities until written direction is received from the Engineer.
- B. Protection of Persons and Property:
  - 1. Barricade open holes and depressions occurring as part of the Work, and post warning lights on property adjacent to or with public access to the work.

2. Operate warning lights during hours from dusk to dawn each day and as otherwise required.
3. Protect existing structures, utilities, sidewalks, pavements, fences and other facilities from damage caused by trenching, settlement, lateral movement, washout, and other hazards created by operations under this Section. All existing features affected and/or damaged by the work of this Section shall be brought back to their original conditions at no cost to the Owner.

C. Dewatering:

1. Remove all water, including rain water, encountered during trench and substructure work to an approved location by pumps, drains, and other approved methods.
2. Keep excavations and site construction free from water.

D. Dust Prevention:

1. Use means necessary to prevent dust becoming a nuisance to the public, to neighbors, and to other work being performed on or near the site in conformance with Standard Specifications.

E. Maintain access to the site at all times.

### 3.3 TRENCHING PROCEDURES

A. Trench Excavation:

1. Construction methods shall conform to Section 206 of Standard Specifications, where applicable.
2. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit.
3. Clearance: 12 inches minimum each side of pipe or conduit.
4. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove stones and sharp objects to avoid point loading.
5. Place and compact bedding material on rock or other unyielding bearing surfaces and to fill unauthorized excavations. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

B. Rock in Trench Excavation:

1. When rock is encountered in work of trench excavation the removal of that rock shall comply with "Standard Specifications"
  2. No additional payment will be made for rock removal during trench excavation.
- C. Comply with pertinent provisions of Section 31 00 00 - Earthwork.
- D. Provide sheeting and shoring as necessary for protection of the Work and for the safety of personnel.
1. Prior to backfilling, remove all sheeting.
  2. Do not permit sheeting to remain in the trenches except when field conditions or the type of sheeting or methods or construction such as the use of concrete bedding are such as to make removal of sheeting impracticable. In such cases, portions of sheeting may be cut off and remain in the trench as approved by the Owner.
- E. Miscellaneous:
1. Short sections of a trench may be tunneled, subject to approval of the Engineer, if the conduit and backfill can be installed and compacted properly into such tunnel.
  2. Where it becomes necessary to excavate beyond the limits of normal excavation lines in order to remove boulders or other interfering objects, backfill and compact the voids remaining after removal of the objects in accordance with Section 31 00 00 at no additional cost to the Owner.
    - a. If a void is below the subgrade for the utility bedding, use suitable earth materials and compact to a relative density of no less than 95%.
    - b. If a void is in the side of the utility trench of open cut, use suitable earth or sand compacted or consolidated to a relative density of no less than 90%.
  3. Excavating for appurtenances:
    - a. Excavate for catch basins, hydrants and similar structures to a distance sufficient to leave at least 12" clear between outer surfaces and the embankment or shoring that may be used to hold and protect the banks.
    - b. Over depth excavation beyond such appurtenances that has not been directed will be considered unauthorized. Fill with sand, gravel, or lean concrete as approved by the Engineer, and at no additional cost to the Owner.
  4. Trench to the minimum width necessary for proper installation of the utility, with sides as nearly vertical as possible. Accurately grade the bottom to provide uniform bearing for the utility.
  5. Depressions:

- a. Dig bell holes and depressions for joints after the trench has been graded. Provide uniform bearing for the pipe on prepared bottom of the trench.
  - b. Except where rock is encountered, do not excavate below the depth indicated or specified.
  - c. Where rock is encountered, excavate rock to a minimum over depth of 4" below the trench depth indicated or specified.
- F. Where utility trenching, piping and/or conduit traverses public property and/or is subject to governmental or utility company jurisdiction, provide depth, bedding, cover, and other requirements and/or regulations as set forth by authority having jurisdiction, but in no case shall the depth be less than that shown in the Contract Documents.
- G. Cover:
  1. Provide minimum trench depth indicated below to maintain a minimum cover over the top of the installed item below the finish grade or subgrade, unless otherwise indicated on Contract Drawings:
    - a. Storm drains: 18"
    - b. Sewer pipes: 36"
    - c. Raceways: 30"
    - d. Water pipes: 48"
    - e. Gas: 36"
  2. Where utilities are under a concrete structure slab or pavement, the minimum depth need only be sufficient to completely encase the conduit or pipe sleeve, provided it will not interfere with the structural integrity of the slab or pavement.
  3. Where the minimum cover is not provided, encase the pipes in concrete as indicated on the Drawings. Provide concrete with a minimum 28 day compressive strength of 3000 psi with entrained air 5 to 7 percent. Mechanically consolidate concrete.

**END OF SECTION 31 23 16.13**

## **SECTION 31 25 00**

### **EROSION AND SEDIMENTATION CONTROL**

#### **PART 1 - GENERAL**

##### **1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Division 1 General Requirements and Specific Requirements, apply to this Section.

##### **1.02 SECTION INCLUDES**

- A. Hay bales, filter fabric fence, sediment barriers and sedimentation structures
- B. Temporary mulch
- C. Temporary sediment basins as required by field conditions

##### **1.03 QUALITY ASSURANCE**

- A. All erosion and sediment control measures will be constructed in accordance with the specifications contained herein.

##### **1.04 PROJECT CONDITIONS**

- A. Land disturbance will be kept to a minimum; re-stabilization will be scheduled as soon as possible. Temporary seeding or permanent hydro-seeding should take place immediately upon completion of grading. Permanent seeding will be scheduled during March 15 - June 15: August 15 - October 15.
- B. Erosion and sediment control measures will be installed prior to construction whenever possible and will be maintained in effective condition throughout the construction period.
- C. Hay bale filters will be installed at the base of all proposed slopes and on the downhill side of any area receiving new planting and as instructed by the Site Architect.
- D. Additional control measures will be installed during the construction period as required by field conditions or as requested by the Site Architect.
- E. Sediment removed from control structures will be disposed of on site in a manner approved by the Site Architect.
- F. Mulch all new slopes 3% or greater. Use straw or hay (70-90 lbs. 1,000 sq. ft.), free of weeds or coarse matter. Chemical binder such as Petroset Terratack Hydro Mulch and Aerospray will be used as recommended by manufacturer to anchor mulch. Mulch must be inspected periodically, in particular, after rainstorms to check for rill erosion. Where

erosion is severe, repair the eroded area and place additional mulch as required to control the erosion. Grasses shall not be considered established until a ground cover is achieved, which is mature enough to control soil erosion and to survive severe weather conditions.

## **PART 2 - PRODUCTS**

### **2.01 MATERIALS**

#### **A. Hay bales:**

1. Hay bales shall be made of hay with 40 lbs. minimum weight, and 120 lbs. maximum weight. The hay bales shall be sufficiently bound with either wire or nylon twine to resist breaking apart during their use, shipment or placement.
2. Stakes shall be wood, minimum two inches (2") by two inches (2") by three feet (3') long.
- 3.

#### **B. Filter fabric:**

1. Synthetic filter fabric shall be a pervious sheet of propylene, nylon, polyester or ethylene filaments and shall be certified by the manufacturer or supplier as conforming to the following requirements:

Minimum Filtering Efficiency:	75%
Minimum Tensile Strength at 20% Elongation	
for Extra Strength:	50 lbs./lin. in.
for Regular Strength:	30 lbs./lin. in.
Minimum Flow Rate:	0.3 gal./min./sq.ft.

- C. Temporary mulch: clean oat straw, wheat straw, timothy hay, a mixture of clover and timothy hay or other approved native or forage grasses; well-seasoned before bailing, free from mature seed-bearing stalks or roots of prohibited or noxious weeds.
- D. Crushed stone: Crushed or broken stone. Gradation shall conform to No. 8 (1/4" stone).

## **PART 3 - EXECUTION**

### **3.01 PREPARATION**

- A. Conduct construction operations in compliance with all terms of regulation agency requirements, including requirements noted on the Contract Drawings.



- B. Retain all sediments within the contract limits, and within designated disposal areas.
- C. Install erosion control measures prior to beginning site disturbance. Maintain erosion control measures throughout construction period, install additional measures if necessary to retain all sediment on site. Install any additional erosion control measures which may be required by local regulatory officials.

### 3.02 SEDIMENT BARRIERS

- A. Sediment barriers shall be limited to hay bales and silt fencing for sheet flow applications installed in accordance with Item 1.01.B.
- B. Hay Bales:
  - 1. Bales shall be placed in a single row, with ends of adjacent bales tightly abutting one another. Bales shall be oriented lengthwise on the contour for sheet flow applications, perpendicular to the contour for channel flow applications, and in a square or rectangular shape around depressed catch basin inlets.
  - 2. Bales shall be installed so that bindings are oriented around the sides rather than along the tops and bottoms of the bales to prevent deterioration of the bindings.
  - 3. The barrier shall be entrenched and backfilled. A trench shall be excavated the width of the bale and the length of the proposed barrier to a minimum depth of four inches (4"). After the bales are staked and chinked, the excavated soil shall be backfilled against the barrier. Backfill soil shall conform to the ground level on the downhill side and shall be built up to four inches (4") against the uphill side of the barrier.
  - 4. For channel flow applications, the barrier shall be extended to such a length that the bottoms of the end bales are higher in elevation than the top of the lowest middle bale to assure that sediment laden runoff will flow either through or over the barrier but not around it.
  - 5. The areas immediately around catch basins may be excavated slightly to increase ponding of runoff water around catch basins.
  - 6. Each bale shall be securely anchored by at least two stakes driven through the bale. The first stake in each bale shall be driven toward the previously laid bale to force the bales together. Stakes shall be driven deep enough into the ground to securely anchor the bales.
  - 7. The gaps between bales shall be chinked with straw to prevent water from escaping between bales.
  - 8. In sloping areas where surface flow follows the bale line, perpendicular bale checks shall be installed at appropriate intervals (100 feet maximum).

C. Filter Fabric

1. Filter fabric shall be wrapped around all existing and proposed trench drain and catch basin and inlet grates to prevent sediment from entering the storm drainage system. The fabric shall be wrapped tightly around the outside of the grate structure and the grate placed securely back inside the receiving frame.
2. Where soil stockpiles are to be placed directly over trench drains or inlets, the fabric shall be wrapped a minimum of two (2) times around the grate structure.

3.03 TEMPORARY MULCH

- A. Place mulch uniformly in a continuous blanket at a rate of 2 ½ tons per acre, or two 50-pound bales per 1,000 square feet of area. A mechanical blower may be used for mulch application. Do not spread/apply mulch by mechanical means or by hand on windy or gusty days.
- B. Crimp straw into soil by mechanical means.
- C. On all slopes 4:1 or steeper, anchor mulch with liquid tackifier applied uniformly at a rate of 60 gallons per acre.
- D. Protect buildings, paving, planting and all non-seeded areas from liquid tackifier over-spray.

3.04 INSPECTION AND MAINTENANCE

A. General

1. Inspection shall be frequent and shall be made after each storm event. Repair or replacement shall be made promptly as needed.

B. Hay Bales

1. Cleanout of accumulated sediment behind the bales is necessary if ½ of the original height of the bales becomes filled with sediment.
2. Hay bales shall be replaced after their expected useful life of 60 days.
3. Bale barriers shall be removed when they have served their usefulness, but not before the upslope areas have been permanently stabilized and the completion of construction activities.

C. Filter Fabric Fence

1. Fabric placed around grates shall be replaced whenever the fabric becomes torn, stretched or otherwise damaged so that it can no longer perform its function.

D. Sedimentation Basins

1. Temporary sedimentation basins shall be cleaned out once one-half of the basin volume becomes filled with sediment.

**END OF SECTION 31 25 00**

**SECTION 32 11 23**  
**PROCESSED AGGREGATE BASE**

**PART 1 - GENERAL**

**1.01 RELATED DOCUMENTS**

- A. The General Provisions of the Contract, including General and Supplementary Conditions, and Division One General Requirements apply to the work specified in this section.
- B. "Standard Specifications" shall mean the State of New York Department of Transportation Standard Specifications, its latest edition and any supplemental specifications.

**1.02 DESCRIPTION OF WORK**

- A. Work Included: Provide and install a processed stone aggregate base in two courses on a prepared subgrade as shown on the Drawings or as ordered by the Engineer, and as specified herein.

**1.03 RELATED WORK**

- A. Section 31 00 00 - Earthwork

**1.04 QUALITY ASSURANCE**

- A. Material Standards: As defined in "Standard Specifications" inclusive of all supplements.
- B. Testing: Compaction tests may be required by NY State and will be paid for by the Contractor. No specific testing schedule has been established at this time. If tests indicate that density requirements have not been achieved, the Contractor shall continue compacting. All re-testing in unsatisfactory areas shall be paid for by the Contractor.
- C. Density and Compaction Testing: The Contractor is responsible to schedule compaction tests as required by the Owner and to allow adequate time for the proper execution of said tests.

**1.05 SUBMITTALS**

- A. Submit certified test reports and materials certificates, for products specified in this Section, indicating compliance of all proposed materials with specified requirements.

**1.06 PROTECTION**

- A. Dust Control: Use all means necessary to control dust on and near the construction areas caused by the Contractor's performance of the work in conformance with Standard Specification.

## **PART 2 - PRODUCTS**

### **2.01 PROCESSED STONE AGGREGATE**

- A. Conform to Standard Specifications, Section 623 – Crushed Stone and Section 703-02.

## **PART 3 - EXECUTION**

### **3.01 SUBGRADE PREPARATION**

- A. Prior to placing the bottom course of processed stone aggregate base, the prepared subgrade shall be maintained true to line and grade, at all times for a minimum distance of 200 feet in advance of the work. No placement of the processed aggregate is to commence until acceptance by the Engineer of the subgrade on which it is to be placed.

### **3.02 COMPACTION REQUIREMENTS**

- A. Compact subgrade soil to not less than the following percentages of maximum dry density according to ASTM 1557:
  - 1. Under foundations, concrete pads, and pavements, compact the top 12 inches below subgrade and each layer of backfill or fill material at 95 percent maximum dry density.
- B. Compact crushed stone aggregate base material with vibratory roller to minimum 95% modified AASHTO laboratory density (ASTM D-1557, Method C).

### **3.03 MATERIAL PLACEMENT/COMPACTION**

- A. Install processed aggregate base material at the locations as shown on the Drawings and in accordance with Standard Specifications, Section 623-3. Dimensions specified are after compaction.

**END OF SECTION 321123**

## **SECTION 32 13 13**

### **PORTLAND CEMENT CONCRETE PAVEMENT AND CURBS**

#### **PART 1 - GENERAL**

##### **1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Division 1 General Requirements and Specific Requirements, apply to this Section.
- B. "Standard Specifications" shall mean the State of New York Department of Transportation Standard Specifications, its latest edition; and any supplemental specifications.

##### **1.02 SUMMARY**

- A. This Section includes the materials, labor, installation and incidental costs for the installation of subbase material, base materials, colored Portland cement concrete, reinforcement and concrete stamping as follows:
  - 1. Reinforced concrete pavement
  - 2. Concrete curb
  - 3. Concrete curb ramps
  - 4. Concrete sidewalk
  - 5. Flora/fauna concrete stamping/imprinting
- B. Coordinate the work of this Section with Section 32 12 16 - Bituminous Concrete Pavement and Markings.

##### **1.03 RELATED SECTIONS**

- A. Section 02 74 10 - Bituminous Concrete Pavement and Markings

##### **1.04 DEFINITIONS**

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, expansive hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.

##### **1.05 SUBMITTALS**

- A. Product Data: For each type of manufactured material and product indicated.
- B. Design Mixes: For each concrete pavement mix.
- C. Color: Color samples for colored concrete. The contractor must receive approval of concrete colors prior to colored concrete work. See plans for concrete colors.
- D. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials. Contractor shall pay for all testing of concrete materials.
- E. Material Certificates: Signed by manufacturers certifying that each of the following materials complies with requirements:
  - 1. Cementitious materials and aggregates
  - 2. Steel reinforcement and reinforcement accessories
  - 3. Admixtures
  - 4. Curing compounds
  - 5. Applied finish materials (i.e., traffic paint)
  - 6. Joint fillers
- F. Product Data Concrete Stamping/Imprinting: Submit manufacturer's complete technical data sheets for the following:
  - 1. Dry-shake colored hardener.
  - 2. Powder antiquing release agent and Liquid clear release agent
  - 3. Imprinting/Texturing tools.
  - 4. Curing compound.

## 1.06 QUALITY ASSURANCE

- A. Materials and methods of construction shall comply with the following standards:
  - 1. American Society for Testing and Materials (ASTM)

2. American Concrete Institute (ACI)
3. The State of New York Department of Transportation Standard Specifications
- B. Installer Qualifications: An experienced installer who has completed pavement work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- C. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.
  1. Manufacturer must be certified according to the National Ready-Mix Concrete Association's Plant Certification Program.
- D. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 shall be paid by the contractor to conduct the testing indicated, as documented according to ASTM E 548.
- E. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant and each aggregate from one source. Do not change source of brands of cement, aggregate materials, or batching plant during course of work.
- F. ACI Publications: Comply with all ACI requirements unless modified by the requirements of the Contract Documents which includes but is not limited to:
  1. ACI 301 "Specification for Structural Concrete for Buildings."
  2. ACI 302 IR "Recommended Practice for Concrete Floor and Slab Construction."
  3. ACI 303.1 "Standard Specification for Cast-In-Place Architectural Concrete."
  4. ACI 304 "Recommended Practice for Measuring, Mixing, Transporting and Placing of Concrete."
  5. ACI 305R "Recommended Practice for Hot Weather Concreting."
  6. ACI 306R "Recommended Practice for Cold Weather Concreting."
- G. American Society of Testing and Materials (ASTM):
  1. ASTM C309 "Standard Specifications for Liquid Membrane-Forming Compounds for Curing Concrete."
  2. ASTM C494 "Standard Specification for Chemical Admixtures for Concrete."
- H. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixes.



I. Concrete Stamp/Imprint Mockup:

1. Provide under provisions of Division 1 Section Quality Control.
2. At location on Project selected by Engineer place, and finish 4 feet by 4 feet area.
3. Construct mockup using processes and techniques intended for use on permanent work, including curing procedures. Include samples of control, construction, and expansion joints in sample panels. Mockup shall be produced by the individual workers who will perform the work for the Project.
4. Accepted mockup provides visual standard for work of Section.
5. Mockup shall remain through completion of the work for use as a quality standard for finished work.
6. Remove mockup when directed.

J. Concrete coloring must be used as intended per the chosen manufacturer's specifications.

1.07 PROJECT CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

## PART 2 - PRODUCTS

2.01 FORMS

- 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. Chamfer Strips: Wood, metal, PVC, or rubber strips,  $\frac{3}{4}$ " by  $\frac{3}{4}$ ", minimum.

- C. 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.

- D. 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.

## 2.02 STEEL REINFORCEMENT

- A. Reinforcing Bars and Tie Bars: ASTM A 615, Grade 60, deformed.

- B. Plain, Cold-Drawn Steel Wire: ASTM A 82.

- C. Steel Welded Wire Fabric: ASTM A 185.

- D. Joint Dowel Bars: Plain steel bars, ASTM A 615, Grade 60. Cut bars true to length with ends square and free of burrs.

- E. Supports for Reinforcement: Chairs, spacers, dowel bar supports and other devices for spacing, supporting, and fastening reinforcing bars, welded wire fabric, and dowels in place. Use wire bar-type supports complying with CRSI specifications.

- 1. Use supports with sand plates or horizontal runners where base material will not support chair leg.

- F. Bending: All reinforcement shall be bent cold. Only competent mechanics shall be employed for cutting and bending, and proper appliances shall be provided for such work. The reinforcement shall be bent to the shapes shown on the plans.

- 1. Bends for stirrups and ties shall be made around a pin having a diameter not less than two times the minimum thickness of the bar.

- 2. Bends for other bars shall be made around a pin having a diameter not less than six times the minimum thickness of the bar.

- 3. For bar larger than one inch the pin shall not be less than eight times the minimum thickness of the bar. Reinforcement shall be formed to the dimensions indicated on the plans before it is embedded in the concrete.

- G. Splices: All Splicing shall be as specified in American Concrete Institute (ACI) Building Code.

- H. Placing and Fastening: Placing and Fastening shall be as specified in ACI Standards. Before any concrete is placed, all mortar shall be cleaned from the reinforcement. No concrete shall be poured until the Engineer has inspected the placing of the reinforcing metal and permission to place concrete is granted. All concrete placed in violation of this provision shall be rejected and removed.

## 2.03 CONCRETE MATERIALS

- A. General: Use the same brand and type of cementitious material from the same manufacturer throughout the Project.
- B. Concrete shall be Class C concrete in conformance with the Standard Specifications, Section 501 – Portland Cement Concrete. Concrete shall be 4000 psi. Batch mixing at project site not acceptable.
- C. Compressive strength: 4,000 psi at 28 days.
- D. Entrained air: 5 to 7%.
- E. Reactive aggregates and calcium chloride are not allowed.
- F. Water: Potable.

## 2.04 ADMIXTURES

- A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cement and to be compatible with other admixtures.
- B. Air-Entraining Admixture: ASTM C 260.
- C. Water-Reducing Admixture: ASTM C 494, Type A.
- D. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.

## 2.05 CURING MATERIALS

- A. Curing/sealing compound shall be equivalent to Day-Chem Sil-Cure J13.

## 2.06 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Premolded Joint Filler Strips: ASTM D-994, premolded, resilient non-extruding joint filler conforming to the requirements of AASHTO M213.
- C. Thickness and depth of expansion- and isolation-joint filler as indicated on the drawings.
- D. Pavement-Marking Paint: Latex, water-base emulsion; ready mixed; complying with FS TT-P-1952.
  - 1. Color: Blue for handicapped requirements, yellow for fire lanes, white elsewhere.

## 2.07 CONCRETE MIXING

A. Ready-Mixed Concrete: Comply with requirements and with ASTM C 94 and ASTM C 1116.

1. When air temperature is between 85 deg F (30 deg C) and 90 deg F (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.

2.08 CONCRETE STAMPING/IMPRINTING

A. ACCEPTABLE MANUFACTURER'S

1. MATCRETE®; 1495 Hudson Avenue, Ontario, California 91761, USA. Toll Free: (800) 777-7063. Tel: (909) 635-0160. Fax: (909) 635-0165. Email: [info@matcrete.com](mailto:info@matcrete.com); Web: [www.matcrete.com](http://www.matcrete.com).
2. Calico Construction Products; web: <https://calicoproducts.com>; Email: [info@calicoproducts.com](mailto:info@calicoproducts.com) Tel: (702)-463-6100
3. Or approved equal.

B. MATERIALS

1. Dry-Shake Colored Hardener: MATCRETE® Dustone Color Hardener™ (or approved equal); factory proportioned, mixed, and packaged, ready-to-use surface hardener.
2. Stamping/Imprinting Tools and Materials: MATCRETE® Decorative Concrete Stamps™ (or approved equal).
3. Powder Antique Release Agent: MATCRETE® Dustone Antique Release Agent™ (or approved equal). Release agent shall be compatible with stamping/imprinting tools and with dry-shake colored hardener.
4. UV-Sealer: MATCRETE® Diamond Seal™ Lacquer Sealer (or approved equal). Sealer shall be compatible with powder antique release agent.

C. COLORS AND PATTERNS

1. Dry-Shake Color Hardener
  - a. Color as selected by Site Architect from MATCRETE® Dustone Color Chart.
    - 1) Tracks: Light Beige
2. Powder Antique Release Agent: Color as selected by Site Architect from MATCRETE® Dustone Color Chart.

**PART 3 - EXECUTION**

### 3.01 SURFACE PREPARATION

- A. Proof-roll prepared subbase surface to check for unstable areas and verify need for additional compaction. Do not begin concrete work until such conditions have been corrected and are ready to receive concrete.
- B. Remove loose material from compacted subbase surface and excavations immediately before placing concrete.

### 3.02 FORMS

- A. Set, brace, and secure forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so that forms can remain in place at least 72 hours after concrete placement.
- B. Check completed formwork and screeds for grade and alignment to following tolerances:
  - 1. Top of Forms: Not more than 1/8 inch in 10 feet.
  - 2. Vertical Face on Longitudinal Axis: Not more than 1/4 inch in 10 feet.
- C. Clean forms after each use and coat with form release agent as required to ensure separation from concrete without damage.
- D. Form recess to receive brick facing masonry in exposed ramp wall as detailed in the Drawings.

### 3.03 PLACING REINFORCEMENT

- A. General: Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars" for placing and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- E. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch (50-mm) overlap to adjacent mats.

### 3.04 JOINTS

- A. General: Construct contraction, construction, and isolation joints true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to the centerline, unless indicated otherwise.
  - 1. When joining existing paving, place transverse joints to align with previously placed joints, unless indicated otherwise.
- B. Contraction Joints: Provide weakened-plane contraction joints, sectioning concrete into areas as shown on Drawings. Construct contraction joints for a depth equal to at least 1/4 of the concrete thickness, as follows:
  - 1. Tooled Joints: Form contraction joints in fresh concrete by grooving and finishing each edge of joint with a radiused jointer tool.
  - 2. Inserts: Form contraction joints by inserting pre-molded plastic, hardboard, or fiberboard strips into fresh concrete until top surface of strip is flush with paving surface. Radius each joint edge with a jointer tool. Carefully remove strips or caps of two-piece assemblies after concrete has hardened. Clean groove of loose debris.
- C. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than ½ hour, unless paving terminates at isolation joints.
  - 1. Provide preformed galvanized steel or plastic keyway-section forms or bulkhead forms with keys, unless indicated otherwise. Embed keys at least 1-1/2 inches into concrete.
  - 2. Continue reinforcement across construction joints unless indicated otherwise. Do not continue reinforcement through sides of strip paving unless indicated.
  - 3. Provide tie bars at sides of paving strips where indicated.
  - 4. Use bonding agent on existing concrete surfaces that will be joined with fresh concrete.
- D. Isolation Joints: Form isolation joints of preformed joint filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
  - 1. Locate expansion joints at intervals of 20 feet, unless indicated otherwise.
  - 2. Extend joint fillers full width and depth of joint, not less than ½ inch or more than 1 inch below finished surface where joint sealant is indicated. Place top of joint filler flush with finished concrete surface when no joint sealant is required.
  - 3. Furnish joint fillers in one-piece lengths for full width being placed wherever possible. Where more than one length is required, lace or clip joint filler sections together.
  - 4. Protect top edge of joint filler during concrete placement with a metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

- E. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour, unless pavement terminates at isolation joints.
  - 1. Provide preformed galvanized steel or plastic keyway-section forms or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
  - 2. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.
  - 3. Provide tie bars at sides of pavement strips where indicated.
  - 4. Use a bonding agent or epoxy bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- F. Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt-coat one half of dowel length to prevent concrete bonding to one side of joint.

### 3.05 CONCRETE PLACEMENT

- A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.
- B. Remove snow, ice, or frost from subbase surface and reinforcing before placing concrete. Do not place concrete on surfaces that are frozen.
- C. Moisten subbase to provide a uniform dampened condition at the time concrete is placed. Do not place concrete around manholes or other structures until they are at the required finish elevation and alignment.
- D. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
  - 1. When concrete placing is interrupted for more than ½ hour, place a construction joint.
- E. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- F. Consolidate concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures to consolidate concrete complying with ACI 309R.
  - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocating reinforcing, dowels, and joint devices.

- G. Screed paved surfaces with a straightedge and strike off. Use bull floats or darbies to form a smooth surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces prior to beginning finishing operations.
- H. Place concrete in two operations; strike off initial pour for entire width of placement and to the required depth below finish surface. Lay welded wire fabric or fabricated bar mats immediately in final position. Place top layer of concrete, strike off, and screed.
  - 1. Remove and replace portions of bottom layer of concrete that have been placed more than 15 minutes without being covered by top layer or use bonding agent if acceptable to Engineer.
- I. Curbs and Gutters: Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete.
- J. Cold-Weather Placement: Comply with provisions of 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 air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
  - 2. Do not use frozen materials or materials containing ice or snow.
  - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.
- K. Hot-Weather Placement: Place concrete complying with ACI 305R and as specified when hot weather conditions exist.
  - 1. Cool ingredients before mixing to maintain concrete temperature at time of placement to below 90 deg F. Mixing water may be chilled 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. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedding in concrete.
  - 3. Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

### 3.06 CONCRETE FINISHING

- A. Float Finish: Begin floating when bleed water sheen has disappeared, and the concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units. Finish surfaces to true planes within a tolerance of 1/4 inch in 10 feet as determined by a 10-foot-long straightedge placed anywhere on the surface in any direction. Cut down high spots and fill low spots. Refloat surface immediately to a uniform granular texture.



1. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across concrete sidewalk surface perpendicular to line of traffic to provide a uniform fine line texture finish.
- B. Final Tooling: Radius: 3/8 inch. Tool edges of paving, curbs, and joints formed in fresh concrete with a jointing tool to the following radius. Repeat tooling of edges and joints after applying surface finishes. Eliminate tool marks on concrete surfaces.
- C. Concrete Imprinting:
  1. Begin imprinting operations immediately after applying powder antique release agent.
  2. After the imprinted concrete surface has hardened sufficiently, the remaining unembedded antique release agent should be removed to the degree desired, using high-pressured water, by scrubbing or by buffing.

### 3.07 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with the recommendations of ACI 306R for cold weather protection and ACI 305R for hot weather protection during curing.
- B. Evaporation Control: In hot, dry, and windy weather, protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control material. Apply according to manufacturer's instructions after screeding and bull floating, but before floating.
- C. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- D. Curing Methods: Cure concrete by curing compound, as follows:
  1. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.

### 3.08 FIELD QUALITY CONTROL TESTING

- A. Employ a qualified independent testing and inspection agency to sample materials, perform tests, and submit test reports during concrete placement as follows:
- B. The Contractor will employ a qualified testing and inspection agency to sample materials, perform tests, and submit test reports during concrete placement. Sampling and testing for quality control may include the following:

1. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.
    - a. Slump: ASTM C 143; one test at point of placement for each compressive-strength test but no less than one test for each day's pour of each type of concrete. Additional tests will be required when concrete consistency changes.
    - b. Air Content: ASTM C 231, pressure method; one test for each compressive-strength test but no less than one test for each day's pour of each type of air-entrained concrete.
    - c. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F (4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each set of compressive-strength specimens.
    - d. Compression Test Specimens: ASTM C 31; one set of four standard cylinders for each compressive-strength test, unless directed otherwise. Mold and store cylinders for laboratory-cured test specimens except when field-cured test specimens are required.
    - e. Compressive-Strength Tests: ASTM C 39; one set for each day's pour of each concrete class exceeding 5 cu. yd. but less than 25 cu. yd., plus one set for each additional 50 cu. yd. Test one specimen at 7 days, test two specimens at 28 days, and retain one specimen in reserve for later testing if required.
  2. When frequency of testing will provide fewer than five strength tests for a given class of concrete, conduct testing from at least five randomly selected batches or from each batch if fewer than five are used.
  3. When total quantity of a given class of concrete is less than 50 cu. yd., the Engineer may waive strength testing if adequate evidence of satisfactory strength is provided.
  4. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
  5. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength and no individual strength test result falls below specified compressive strength by more than 500 psi.
- C. Test results will be reported in writing to the Engineer, concrete manufacturer, and Contractor within 24 hours of testing. Reports of compressive strength tests shall contain the Project identification name and number, date of concrete placement, name of concrete testing agency, concrete type and class, location of concrete batch in paving, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-day and 28-day tests.
- 3.09 REPAIRS AND PROTECTION
- A. Remove and replace concrete paving that is broken, damaged, or defective, or does not meet the requirements of this Section.

- B. Drill test cores where directed by the Engineer when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with Portland cement concrete bonded to paving with epoxy adhesive.
- C. Protect concrete from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep concrete paving not more than 2 days prior to date scheduled for Substantial Completion inspections.

### 3.10 PROTECTION/CLEAN-UP

- A. Protect work completed until acceptance of project. Replace or repair concrete if damaged prior to acceptance.
- B. As work proceeds, maintain premises free of unnecessary accumulation of tools, equipment, surplus material, and debris related to this work.

**END OF SECTION 321313**

**SECTION 32 31 13**

**CHAIN-LINK FENCES, GATES AND BACKSTOPS**

**PART 1 - GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions and Special Conditions, apply to this Section.
- B. "Standard Specifications" shall mean the State of New York Department of Transportation Standard Specifications, May 1, 2024; its latest edition; and any supplemental specifications.
- C. Examine all other Sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.
- D. Coordinate work with trades affecting, or affected by, work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

**1.02 SECTION INCLUDES**

- A. Perform all work required to complete the work of the Section, as indicated. Such work includes, but is not limited to, the following:
  - 1. 4' Chain-link Fence (Fusion Bonded Fabric and Powder Coated Framework and Fittings) and Fence Guard
  - 2. 6' Chain-link Fence (Fusion Bonded Fabric and Powder Coated Framework and Fittings) and Fence Guard (if necessary)
  - 3. 10' Chain-link Fence (Fusion Bonded Fabric and Powder Coated Framework and Fittings) and Fence Guard (if necessary)
  - 4. Baseball and Softball Chain-link Backstop with Overhang

**1.03 RELATED SECTIONS**

- A. Section 31 25 00 – Erosion and Sedimentation Control
- B. Section 02 41 13 – Site Demolition and Removals
- C. Section 31 23 16.13 – Trenching

#### 1.4 REFERENCES

- A. ASTM - American Society for Testing and Materials

#### 1.5 LAWS, ORDINANCES, PERMITS AND FEES

- B. The Contractor shall:

1. Give necessary notices, obtain all permits and pay all Governmental taxes, fees and other costs in connection with this work, file all necessary plans, prepare documents and obtain all necessary approvals of the local Building Departments having jurisdiction.
2. Obtain all required certificates of inspection for this work and deliver same to the Landscape Architect before request for acceptance and final payment for the work.
3. Include in the work, without extra cost to the Owner, any labor, materials, services, apparatus, drawings (in addition to Contract Drawings and Documents) in order to comply with all applicable laws, ordinances, rules and regulations, whether or not shown on the Drawings and/or specified.

#### 1.6 QUALITY ASSURANCE

- A. Source: For each type of product required for the work of this Section, provide products of one manufacturer and source for consistency.
- B. Codes and Standards: Perform site improvements work in compliance with applicable requirements of governing authorities having jurisdiction. Workmanship and finish shall be equal to the best practice of modern shops for each item of work.
- C. Qualifications of Workers: Use adequate numbers of skilled workers who are trained in the necessary crafts and who are completely familiar with the specified requirements and methods needed for proper performance of the work of this Section.
- D. The work of this Section shall be completely coordinated with the work of other Sections. Verify dimensions and work of other trades which adjoin materials of this Section before installing items specified.

#### 1.7 SUBMITTALS

- A. Product Information: Provide manufacturer's data showing installation and limitations in use. Supply Certificates of Compliance for all materials required for fabrication and installation. Work includes but is not limited to the following items:
  1. 4' Chain-link Fence (Fusion Bonded Fabric and Powder Coated Framework and Fittings) and Fence Guard
  2. 6' Chain-link Fence (Fusion Bonded Fabric and Powder Coated Framework and Fittings) and Fence Guard (if necessary)
  3. 10' Chain-link Fence (Fusion Bonded Fabric and Powder Coated Framework and Fittings) and Fence Guard (if necessary)
  4. Baseball and Softball Chain-link Backstop with Overhang
- B. Material Selection and Samples: Submit samples showing the complete range of colors,

textures and finishes available for all components required for construction. Work includes but is not limited to the following:

1. Provide a 12" x 12" sample of fence fabric.
  2. Provide a 12" section of each type of fence or gate pipe required.
  3. Provide a 6" sample of fabric tie material.
- C. Shop Drawings: Supply shop drawings at an approved scale for location, installation and erection of all parts of the work under this Section including but not limited to the following:
1. 4' Chain-link Fence (Fusion Bonded Fabric and Powder Coated Framework and Fittings) and Fence Guard
  2. 6' Chain-link Fence (Fusion Bonded Fabric and Powder Coated Framework and Fittings) and Fence Guard (if necessary)
  3. 10' Chain-link Fence (Fusion Bonded Fabric and Powder Coated Framework and Fittings) and Fence Guard (if necessary)
  4. Baseball and Softball Chain-link Backstop with Overhang

## PART 2 - PRODUCTS

### 2.1 CHAIN-LINK FENCES

- A. The types of fencing required for the project are as indicated below, subject to detailed material requirements which follow.
- B. All fencing material shall be black.
- C. All material shall be new, and products of recognized reputable manufacturers. Used, re-rolled or re-galvanized materials are not acceptable.
- D. Like items of materials provided hereinafter shall be the end products of one manufacturer in order to achieve standardization for appearance, maintenance and replacement.
- E. Fencing Fabric Wire shall conform to the following:
1. Fabric shall be premium grade helically wound and woven steel core wire in accordance with ASTM F668 for Class 2B vinyl fabric. Color to be black.
  2. Material specifics shall be as follows:

Core	Wire (inches)	Zinc (gauge)	Mesh (oz/S.F.)	Size
All Fence Heights	0.192	6	.30	1 3/4"

3. Selvages: Fence fabric shall be knuckled selvage at top and bottom.

- F. Powdercoated framework shall be steel pipe - Type II: Cold formed and welded steel pipe complying with ASTM F 1043, Group IC, with minimum yield strength of 50,000 psi (344 MPa), sizes as indicated. Protective coating per ASTM F 1043, external coating Type B, zinc with organic overcoat, 0.9 oz/ft<sup>2</sup> (275 g/m<sup>2</sup>) minimum zinc coating with chromate conversion coating and verifiable polymer film. Internal coating Type B, minimum 0.9 oz/ft<sup>2</sup> (275 g/m<sup>2</sup>) zinc or Type D, zinc pigmented, 81% nominal coating, minimum 3 mils (0.08 mm) thick. Color to be black.

- G. Schedule of pipe sizes shall be as follows:

Application	Height (Feet)	Out. Dim. (Inches)	Weight (lbs/foot)
Terminal/ Corner Posts	6'-0" & less	2.375	3.117
	over 6'-0"	4.00	6.56
Line Post Over 6'-0"	6'-0" & less	1.90	2.281
	2.875	4.64	
Rails and Braces	(all heights)	1.660	1.83

1. Posts shall be of sufficient length to allow for installation into concrete footings to a minimum depth of 3'-8" below finish grade (or properly secured in the approved cast-in-place curb).
  2. Post tops shall be provided with powder coated black, domed post caps which fit securely and exclude moisture.
- H. Top Rails shall have lengths not less than eighteen feet and shall be fitted with min. 6 inch long outside sleeved or internally swaged couplings for connecting the lengths into a continuous run. Provide top rail with pass-through fittings at line posts and rail end cups and brace bands at terminal or gate posts.
- I. Middle and Bottom Rails shall be properly secured to line posts with steel boulevard clamps, and to terminal, corner, gate or pull posts with rail end cups and brace bands.
- J. Brace Rails shall be provided for each terminal post with fabric height of six feet or more. Extend brace to each adjacent post at approximate mid-height of fabric and secure with rail end cups and brace bands. Provide diagonal truss bracing with 3/8 inch steel rod and turnbuckle.
- K. Fence fittings and accessories shall be fabricated of steel or cast iron and shall conform to minimum requirements of ASTM F-626, and as below. Following fabrication and galvanizing, all fence fittings shall receive a 10 to 14 mil thick fusion bonded vinyl coating to match fabric color. With the exception of field painting for nuts and bolts, no painted fittings will be accepted.
1. Stretcher Bars shall not be less than 3/16 by 3/4 inch and not less than 2 inches shorter than the nominal height of the fabric with which they are to be used. One stretcher bar shall be provided for each end and gate post, and two for each corner and pull post.

2. Fabric connectors shall be provided in sufficient number for attaching the fabric to all line posts at intervals not exceeding twelve inches (12"); and not exceeding twelve inches (12") when attaching fabric to top or bottom rail. Connectors shall be galvanized with a min. 0.8 oz s.f. coating of zinc.
3. Unless designated otherwise on the details, tie wires shall be fabricated from rolled 9 gauge wire stock which has been cut to required lengths for hand-twisted connections at the site. Color to be black.
4. Tension Bands shall be provided in sufficient number for attaching the fabric and stretcher bars to all terminal posts at intervals not exceeding twelve inches (12"). Tension bands shall be formed from flat or beveled steel and shall have a minimum thickness after galvanizing of 0.078 inch; and minimum width of 3/4 inch for posts 4 inch O.D. or less; and 0.108 inch thickness by 7/8 inch for posts larger than 4 inch O.D. Brace bands shall be formed from flat or beveled steel and shall have a minimum thickness of 0.108 inch after galvanizing; and a minimum width of 3/4 inch. Attachment bolts shall be 5/16 x 1-1/4 inch galvanized carriage bolts with nuts, ASTM A-307, Grade A.
5. Other hardware required shall be fabricated from steel, and galvanized in accordance with ASTM A123 and/or ASTM A153.

L. Chain-link Swing Gates:

1. Fabricate chain-link swing gates in accordance with ASTM F 900 using galvanized 2" steel tubular members weighing 2.60 lb/ft. Fusion or stainless steel welded connections forming rigid one-piece unit. Frames shall be powder coated black (or thermally fused with minimum 10 mils per ASTM 1043). Coating before fabrication will not be allowed. Gates over 8' high or 15' wide shall be provided with additional horizontal and vertical members to ensure proper strength.
2. Chain-link fabric for gates shall match fabric of fencing.
3. Gate posts shall be steel pipe – type II finished to match fence posts:

<u>Gate Leaf</u>	<u>Post Size (inches)</u>	<u>Weight (lb/ft.)</u>
10 ft	4.00	9.11
8 ft	4.00	9.11
6 ft	4.00	9.11
4 ft	2.875	5.79

4. Gate hinges shall be heavy-duty offset type. Install gate for 180-degree outward operation. Hinges shall have large bearing surfaces for clamping in position. The hinges shall not twist or turn under the action of the gate. The gates shall be capable of being opened and closed easily by one person.
5. All gates shall be equipped with a positive closure latch and padlock fitting.
6. Double gates shall be equipped with a drop rod to hold the inactive leaf. Provide gate stop pipe to engage center drop rod. Provide locking device and padlock eyes as an integral part of the latch, requiring one pad lock for locking both leaves.

2.2 FENCE GUARD

- A. Fence Guard shall include the following:



1. Premium grade – 3" wide x 4 ½" high x 8' long with a wall thickness of .09", constructed of heavy duty, UV-resistant polyethylene secured with ties as provided by Beacon Athletics, 2222 Evergreen Road #2, Middleton, WI 53562-4231, (800) 747-5985, or Approved Equal. Color to be yellow.

## 2.3 BASEBALL and SOFTBALL CHAIN-LINK BACKSTOP WITH OVERHANG

- A. The types of fencing required for the project are as indicated below, subject to detailed material requirements which follow.
- B. All material shall be new, and products of recognized reputable manufacturers. Used, re-rolled or re-galvanized materials are not acceptable.
- C. Like items of materials provided hereinafter shall be the end products of one manufacturer in order to achieve standardization for appearance, maintenance and replacement.
- D. Fabric shall be premium grade helically wound and woven steel core wire in accordance with ASTM F668 Class 2B vinyl fabric.
- E. Fabric Material specifics shall be as follows:

	Core (inches)	Wire (gauge)	Zinc (oz/S.F.)	Mesh Size
Back and Sides	0.192	6	.40	1 3/4"
Roof	0.148	9	.30	1 3/4"

1. Selvages: Fence fabric shall be knuckled selvage at top and bottom.
- F. Framework shall be steel pipe, as specified below. Color to be black.
    1. Schedule of pipe sizes shall be as follows:
      - a. Corner, End and Line Posts: 4" o.d, Schedule 120 (double-extra strong). Contractor must submit samples for approval.
      - b. Horizontal Rails: 1.9" o.d (48 mm), 2.72 lbs/ft.
    2. Posts shall be of sufficient length to allow for installation depths as shown on Drawings.
    3. Post tops shall be provided with post caps which fit securely and exclude moisture.
  - G. Top Rails shall have lengths not less than eighteen feet and shall be fitted with min. 6 inch long outside sleeved or internally swaged couplings for connecting the lengths into a continuous run. Provide top rail with pass-through fittings at line posts and rail end cups and brace bands at terminal or gate posts.
  - H. Middle and Bottom Rails shall be secured to line posts with steel boulevard clamps, and to terminal, corner, gate or pull posts with rail end cups and brace bands.

- I. Brace Rails shall be provided for each terminal post with fabric height of six feet or more. Extend brace to each adjacent post at approximate mid-height of fabric and secure with rail end cups and brace bands. Provide diagonal truss bracing with 3/8 inch steel rod and turnbuckle.
- J. Fence fittings and accessories shall be fabricated of steel or cast iron and shall conform to minimum requirements of ASTM F-626, and as below. Following fabrication and galvanizing, all fence fittings shall receive a 10 to 14 mil thick fusion bonded vinyl coating to match fabric color. With the exception of field painting for nuts and bolts, no painted fittings will be accepted.
  - 1. Stretcher Bars shall not be less than 3/16 by 3/4 inch and not less than 2 inches shorter than the nominal height of the fabric with which they are to be used. One stretcher bar shall be provided for each end and gate post, and two for each corner and pull post.
  - 2. Fabric connectors shall be provided in sufficient number for attaching the fabric to all line posts at intervals not exceeding twelve inches (12"); and not exceeding twelve inches (12") when attaching fabric to top or bottom rail. Connectors shall be galvanized with a min. 0.8 oz s.f. coating of zinc.
  - 3. Unless designated otherwise on the details, tie wires shall be fabricated from rolled 9 gauge wire stock which has been cut to required lengths for hand-twisted connections at the site.
  - 4. Tension Bands shall be provided in sufficient number for attaching the fabric and stretcher bars to all terminal posts at intervals not exceeding twelve inches (12"). Tension bands shall be formed from flat or beveled steel and shall have a minimum thickness after galvanizing of 0.078 inch; and minimum width of 3/4 inch for posts 4 inch O.D. or less; and 0.108 inch thickness by 7/8 inch for posts larger than 4 inch O.D. Brace bands shall be formed from flat or beveled steel and shall have a minimum thickness of 0.108 inch after galvanizing; and a minimum width of 3/4 inch. Attachment bolts shall be 5/16 x 1-1/4 inch galvanized carriage bolts with nuts, ASTM A-307, Grade A.
  - 5. Other hardware required shall be fabricated from steel, and galvanized in accordance with ASTM A123 and/or ASTM A153.
- K. Backstop baseboards shall be provided per the Drawings.

### **PART 3 - EXECUTION**

#### **3.1 CHAIN-LINK FENCES**

- A. General: Unless modified herein, installation of fencing shall meet the requirements of ASTM F567. Erect fencing in straight lines between angle points by skilled mechanics experienced in this type of construction.
- B. Post Holes: Post holes for line posts shall be excavated to a minimum size of fifteen inches by forty eight inches (15"x48"). For fences six feet (6') and taller post holes shall be excavated to a minimum size of eighteen inches by forty-eight inches (18" x 48"). Post holes for terminal or gate posts shall have a minimum diameter of eighteen inches (18"), by respective depths as specified.

1. Backfill concrete to within 6 inches of finished grade and crown top to shed water.
  2. Set posts with plumb vertical alignment.
- C. Space posts in the fence line equally with the maximum spacing shown on Drawings.
- D. Provide corner or pull posts at maximum intervals of 250 ft. O.C., and for any change in direction of 15 degrees or more, and for any abrupt change in grade, with bracing in both directions.
- E. Hanging Fabric:
1. Fasten chain-link fence fabric to terminal posts, and gate posts with tension bars and tension bar bands.
  2. Fasten chain-link fence fabric on field side of fence.
  3. Fasten chain-link fence fabric on outside of perimeter fence (if required).
  4. Fence fabric shall be secured to all rails and to posts that are not terminal, or gate with wire ties at specified spacing. Tie down wire shall be woven through the fence fabric, completely around the rail and wire shall be twisted securely with three twists on the rail side of the fence and the tails of the wire cut off to preclude untwisting by hand. Twisted tie wire ends shall be turned under at horizontal rails and turned down at vertical rails to reduce potential for human contact.
  5. Stretch fabric as tightly as possible without pulling the material out of shape. Top of fabric shall be parallel with top rail.
- F. Testing of Fence Fabric, each fence panel shall be constructed such that it will pass the following test. Deflection of fence fabric shall be no greater than 2 inches when a force of 30 pounds is applied in the center of the panel, perpendicular to the plane of the fence fabric. Fabric shall return to original position when force is released.
- G. Gates shall be installed in conformance with specification and detail requirements. Test swing and latch and adjust as necessary for proper operation.
- 3.2 FENCE GUARD
- A. Install per manufactures recommendations on all fences surrounding the field.
  - B. Additional drilling and ties may be required at the discretion of the Landscape Architect.

**END OF SECTION 32 31 13**